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FINAL REPORT

This evaluation reports the results of research and analysis undertaken by the U.S. Census Bureau. It is part of a broad program, the Census 2000 Testing, Experimentation, and Evaluation (TXE) Program, designed to assess Census 2000 and to inform 2010 Census planning. Findings from the Census 2000 TXE Program reports are integrated into topic reports that provide context and background for broader interpretation of results.

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THE EFFECT OF PAY, FRONTLOADING, AND OTHER FACTORS ON THE CENSUS 2000 NON-RESPONSE FOLLOW-UP

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Authors: Lou Jacobson and Ian Petta

Westat
Rockville, Maryland

EXECUTIVE SUMMARY

This report examines (1) differences in how quickly the Census 2000 Non-Response Follow-Up (NRFU) was carried out in the Local Census Offices (LCOs); (2) differences in how quickly the 2000 NRFU was completed relative to the 1990 NRFU; and (3) the underlying reasons for those differences. Overall, we demonstrate that the Census Bureau's plan to raise wages to at least 75 percent of local levels and to put to work during the first week twice the number of enumerators that would be needed if there were no attrition, directly led to dramatic improvement in speed relative to the 1990 NRFU.

Hourly pay was increased by 37.8 percent on average relative to 1990 (adjusted for inflation), and the associated increase in enumerator retention was 22.6 percent. This increase in retention, coupled with introducing frontloading (increasing the number of enumerators at work at the outset relative to cases to complete), permitted the average 2000 LCO to complete the NRFU in 7.19 weeks compared to 9.72 weeks in 1990. Moreover, in 2000, the slowest performing LCOs completed their work about 1.5 weeks faster than the fastest performing LCO in 1990.

Our analysis of the variation in completion time across the 510 LCOs with adequate data (out of a total of 520 LCOs) shows that (1) differences in the degree of frontloading (the number of enumerators at work in a given LCO during the first week) was the primary source of variation in completion time; (2) differences in the number of cases completed by individual enumerators played only a small role; and (3) differences in retention of individual enumerators were too small to have much of an effect.

Our analysis of the influence of factors within and outside of the control of the Census Bureau, using administrative databases covering the 510 LCOs plus a survey database covering close to 2,800 enumerators in 376 crews in 27 LCOs, showed that the NRFU was completed most rapidly (1) in low-wage areas and areas where applicants' test scores were low on average; (2) in the Denver and Los Angeles Census Regions where managers ensured that high levels of frontloading were achieved; and (3) in LCOs that had fewer cases to complete (relative to larger scale offices), and in offices in which local census managers (LCOMs) did not turn over.

Our first overall conclusion from this analysis is that differences in factors outside of the control of census managers, such as the labor force and area characteristics, had small effects on

completion time and productivity. In contrast, factors largely within census management control, such as the total number of LCOs, the number of cases to complete within a given LCO, census pay levels, and regional office planning and oversight, had large effects on performance.

Indeed, our statistical analyses and conversations with Census Bureau officials at all levels strongly suggest that where the basic pay, recruiting, and frontloading plans were followed, LCOs succeeded in securing and retaining more than enough applicants to staff the NRFU with highly competent enumerators who also were strongly motivated to work as long as needed. That LCOs' performance was not supply-constrained complicated our statistical analysis; but far more importantly, in contrast with 1990, it put census managers in the position of having the staff needed to complete the NRFU on schedule.

Thus, our second, but single most important, conclusion was that the degree to which LCOs exceeded schedules was largely a function of the amount of frontloading they achieved. About 80 percent of the LCOs met or exceeded frontloading goals. However, the roughly 20 percent of the LCOs that did not meet their frontloading goals took about 2 additional weeks to reach their week 1 goals. Understanding why frontloading goals were not met, therefore, is the key to understanding the source of variation in speed.

We doubt that failure to achieve frontloading goals was due to recruiting shortfalls. Every LCO had at least 3.25 applicants for each enumerator slot, and most LCOs had more than eight applicants for each slot. Thus, we suspect that one or more of the following three hiring explanations led to those shortfalls: (1) hiring was inherently more difficult due to factors outside of census management control, (2) hiring was not effectively managed, and (3) managers did not feel it was essential to meet frontloading goals.

Unfortunately, we lacked the data needed to definitively sort out the relative importance of the three explanations. Missing information included the number, timing, and refusal rate of applicants asked to accept enumerator positions, and the intentions of census managers. However, we suspect that management ability and discretion largely determined hiring outcomes. First, both our analyses of recruiting and enumeration suggest that factors outside of management control had little effect on those outcomes. Second, evidence from these studies demonstrated that management problems in some LCOs, particularly those where LCOMs had to be replaced prior to the start of the NRFU, strongly affected performance.

We, therefore, reached our third, but somewhat speculative, conclusion that improvements in the hiring process were needed to meet frontloading goals. Possible improvements include starting the hiring process earlier and ensuring enough hiring clerks and phone lines are available to offset unexpected hiring difficulties. Thus, much as frontloading of enumerators was the key to dramatically increasing the speed in conducting the enumeration, increasing hiring capacity appears to be the key to meeting frontloading goals.

A fourth conclusion is that setting pay competitively was essential to recruiting sufficient numbers of well-qualified applicant and to retaining enumerators as long as they were needed. However, the high degree of frontloading led the NRFU to be completed so quickly that it was impossible for us to determine whether enumerators were being released by census managers or quitting while their services were still needed. Thus, we could not directly determine what would have happened during the NRFU had pay been set at a different level. We do know from our separate recruiting study that it would have been more difficult to meet recruiting goals had pay been set lower.)

What our results suggest is that census pay exceeded the threshold above which people who agreed to accept enumerator positions were sufficiently competent to execute the work and would not lightly break their commitments to work while their services were required. Indeed, about 90 percent of the 2000 enumerators showed themselves to be highly productive, as measured by the number of cases they were able to complete per hour. In contrast, during the 1990 NRFU, 50 percent or more of the enumerators had difficulty completing assignments and/or quit before completing even their initial assignment.

The sharp contrast between pay and performance in 2000 versus 1990 has several important implications. Perhaps the most important is that the Census Bureau should reassess how test scores and availability to work many hours are used as hiring screens. In 2000 (and 1990) enumerators were expected to work at least 20 hours a week, and when feasible, preference was given to hiring enumerators able to work at least 40 hours a week. However, once the 20 or 40 hour "availability" threshold was met, test scores were used to order candidate contacts. Our analysis suggests that the capacity to quickly complete the NRFU would have been enhanced had test scores of about 82 percent been used as a threshold (unless applicants had some special skill such as fluency in a foreign language) and the contact order been based on hours of availability (reported in applications).

Our final key conclusion is that the equations produced here could be extended to set the schedule and the degree of frontloading for the 2010 NRFU in a way that would substantially reduce cost without reducing the probability the schedule is met. However, our analysis only looked at completion speed, which is just one criterion on which the success of the NRFU should be judged.

It is our view that only by knowing the relationship between speed and accuracy can the optimal schedule for the NRFU be set. The accuracy/speed/cost tradeoff is of critical importance because (1) improving accuracy is of enormous importance, if the improvements can be achieved at a reasonable cost, and (2) it is expensive to more quickly complete the NRFU, but rushing to complete the NRFU too quickly could reduce accuracy.

Increasing speed is costly because the less time that is allotted, the more enumerators need to be put to work, and the less flexibility crew leaders have to assign the most work to the most effective enumerators. Putting to work more enumerators is also costly because about one-third of all compensation is spent on training and supervision. Not allotting work to the most effective enumerators is costly because, within any given LCO, above average enumerators complete about twice as many cases per hour as below-average enumerators. Thus, even if the 2000 goal of completing 95 percent of the cases in the first 6 weeks was retained, major cost reductions could be achieved if a plan was implemented to use the full 6 weeks to reach the 95 percent point, rather than complete the NRFU as quickly as possible.

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1. INTRODUCTION

This report describes our analysis of the effect of pay, frontloading, and other factors on how quickly the Census 2000 Non-Response Follow-Up (NRFU) was completed. Census 2000 was by far the largest peacetime operation conducted by the Federal government. From late April to late June of 2000 the houses of about 42.4 million people who failed to return their census forms, were visited by about 510,000 enumerators at a cost of roughly $2.4 billion. The enumerators were supervised by about 5,000 managers working in 520 local census offices (LCOs) and 40,000 crew leaders and crew leader assistants. An additional 30,000 or so workers provided clerical support. Oversight for LCOs operations were provided by a staff of about 1,000 working out of 12 regional census centers and the Census Bureau headquarters in Suitland, Maryland.

One of the most remarkable elements of the NRFU is that almost all of the staff were temporary employees, most of whom were hired and trained only weeks before the start of NRFU field operations. To staff the NRFU, about 2 million applicants, roughly 1.6 percent of the entire U.S. workforce, were recruited from October 1999 through April 2000.

The primary focus of our work is determining whether raising wages paid to enumerators and introducing frontloading[1] had the desired effect of allowing the Census Bureau to rapidly complete the NRFU. A secondary interest is determining whether there were systematic differences in performance that could be linked to the characteristics of enumerators, the areas in which they worked, their pay, or the way in which they were managed that should be taken into account when conducting the 2010 decennial census.

This report builds on our earlier studies. More specifically, Sections 2 through 6 are largely based on our *Analysis of How to Set Wage-Rates and Other Parameters in Order to Estimate Cost and Successfully Complete the 2000 Non-Response Follow-Up*, which we completed in June 1997. In that report we used a 20 percent sample of enumerators working in 269 of the 421 local census offices conducting the 1990 NRFU to (1) describe how quickly the 1990 NRFU was executed, (2) determine what factors were associated with differences in speed, and (3) develop a model that could predict how

[1] Frontloading was a strategy adopted for the 2000 Census to hire two times more enumerators than would be required if there was no attrition. Frontloading was aimed at having enough enumerators at work during the first week to handle any contingency and minimize hiring after field operations were underway.

changes in factors under the Census Bureau's control would affect completion speed and cost of the 2000 NRFU. The primary factors examined were enumerator pay rates and the number of enumerators at work the first week relative to the number of cases to be completed.

Our findings of central importance are the following:

- High enumerator turnover led to the 1990 NRFU being completed more slowly and at a higher cost than was planned.
- Differences in census pay relative to locally prevailing pay accounted for many of the differences in enumerator turnover.
- Increasing the ratio of census pay relative to locally prevailing pay to above 75 percent in every office would have reduced enumerator turnover to the point that performance and cost goals could have been met. (The average 1990 pay ratio was 0.576, but the ratio was below 0.450 in some major cities.)
- Increasing initial hiring by about 20 percent coupled with increasing the pay ratio to 0.750 would have allowed the 1990 NRFU to be completed about 2 weeks sooner and would have reduced cost by about 5 percent.
- In order to complete the 2000 NRFU within 6 weeks, it would be optimal to raise the wage ratio to about 0.81[2] and increase the number of enumerators at work in week 1 by roughly 50 percent over 1990 levels.
- Setting pay too low or not having enough enumerators at work in week 1 increases completion time and cost out of proportion to the size of the shortfalls. In contrast, increasing wages and the number of enumerators only slightly increases cost but guards against contingencies that otherwise would prevent the NRFU from being successfully completed.
- High attrition in 1990 may have been due to enumerators being unable to competently complete their assignments, as well as not having sufficient financial incentives to remain at their census jobs. Thus, we may have underestimated the benefits of increasing pay because higher wages should induce better-qualified individuals to apply for jobs.

A panel of outside experts as well as officials within the Census Bureau and the Department of Commerce reviewed our analysis. There was widespread agreement that our analysis was sound and ultimately was used to shape the plans for Census 2000. The Census Bureau decided to introduce

[2] During the 1990 NRFU a $1 bonus for each case completed was paid once a minimum number of cases were completed each week. The same bonus also was included in the original plan for the 2000 NRFU. Following the 2000 dress rehearsal, the bonus was dropped because it was difficult to administer, and using those funds to increase hourly pay would greatly improve recruiting. Prior to eliminating the bonus, our pay recommendation was 0.77.

frontloading so that there would be many more enumerators at work during the first week of the NRFU than would be needed if there were no attrition. They gave us the assignment of setting wages for each local census office (LCO) so that enumerator pay would be at least 75 percent of locally prevailing wages. The Census Bureau felt that taking these steps would make it feasible to achieve the key goals of completing the bulk of the NRFU within 6 weeks and completing the entire field operation within 9 weeks.

The Census Bureau exceeded our recommendations for frontloading because it was uncertain that our estimates were accurate and, as noted above, the cost of the additional hiring was low, but that hiring would greatly increase the chances that the schedule would be met. Indeed, our analysis suggested that there was a limit to the improvements in retention that could be secured by increasing wages, but no limit to the improvements in speed that could be secured by increasing the number of enumerators at work.

Prior to conducting the dress rehearsals during the spring of 1988 in Sacramento, California, and Columbia, South Carolina, there was substantial uncertainty about the applicability of our estimates to current conditions. However, the experience of the dress rehearsals, documented in our December 1999 report, indicated that our estimates were accurate and the overall Census Bureau plan was sound.

A full description of the procedures used to set wages is contained in our report *Setting Census 2000 Temporary Staff Pay Rates*, which was issued in February 2001. In brief, wages were set by (1) estimating average hourly wages for the counties constituting each LCO using *Employment and Wages* data published by the Bureau of Labor Statistics, (2) taking 75 percent of the estimates and rounding to the next highest 25-cent interval, (3) raising wages in both LCOs near high-wage cities to reflect commuting patterns and in LCOs in rural areas to avoid having large differences across contiguous LCOs, and (4) modifying the initial recommendations to take into account special circumstances based on reviews by regional Census Bureau officials. The most common special circumstance was disparity between the peak number of residents and number of full-year residents in resort communities. Raising wages to take commuting patterns and special circumstances into account led wages in the average LCO to equal 81 percent of locally prevailing wages (the level we recommended in the absence of bonuses).

2. PAY AND PERFORMANCE DURING THE 1990 NRFU

Table 2-1 describes how pay varied across the 269 (out of 421) LCOs[3] for which we had sufficient data to carry out our analysis and relates the pay differences to differences in enumerator retention, weeks it took to complete the NRFU, and the population density of the LCOs. The LCOs are grouped based on how many standard deviations from average was the difference between local pay and census pay.

The table clearly shows very large differences in local pay across the LCOs, but relatively narrow differences in census pay. As a result, the ratio of local pay to census pay averaged only .417 in the 11 LCOs with the largest difference between local and census pay, and the relative pay ratio was .516 in the 30 LCOs with pay differences between 1 and 2 standard deviations above average. The pay ratio was much higher, .611, in the 118 LCOs with pay differences between 1 and 2 standard deviations below average.

Column 5 of Table 2-1 shows that there was a strong association between differences in pay ratios and retention during the first 5 weeks of the NRFU, when as many enumerators as possible were needed to be at work. The differences in retention were particularly large between groups A and B, and almost as large between groups B and C; however, the difference was not especially large among LCOs with pay ratios above .560. These results suggest that (1) when pay is far below local rates it is very difficult to retain workers, (2) pay increases should substantially increase retention, but (3) the effect of the increases diminishes as pay rises.

Column 6 shows that low retention was associated with considerably longer durations for completing the NRFU. "Retention per Week" is calculated as the average percentage of enumerators in an LCO staying from one week to the next. Of particular note, even the group with the highest retention took 9 weeks to complete the NRFU. This result suggests that higher wages and more enumerators working at one time would be required to complete the bulk of the 2000 NRFU in 6 weeks.

Finally, column 7 shows that there was a strong association between high local pay and high population density. This suggests that the variation in census pay across LCOs in 1990 was much less

[3] In 1990, the local offices were called "District Offices." In 2000, they were called local census offices or LCOs. In this paper we refer to the 1990 District Offices as LCOs for consistency of presentation.

than the variation in local pay. As a result, the ratio of census pay to local pay was much lower in high pay areas, such as large cities, than in low pay areas.

In summary, in 1990, variation in the ratio of census pay to local pay was large, with the lowest ratios being in LCOs with high population densities. Further, in general, the lower the census pay relative to local pay in an LCO, the lower the retention rate and the longer the duration of the 1990 NRFU.

Table 2-1. Differences in pay and performance during the 1990 NRFU

Group	LCO in group	Local pay	Census pay	Pay ratio	Retention per week	Weeks open	Population density
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A	11	$19.07	$7.96	.417	.658	11.00	2,039
B	30	$14.14	$7.30	.516	.706	10.07	1,354
C	77	$12.28	$6.93	.564	.738	9.99	809
D	118	$10.28	$6.28	.611	.750	9.47	661
E	33	$8.65	$5.65	.653	.747	9.00	128
All	269	$11.39	$6.56	.576	.738	9.72	772

Note: Group A includes LCOs with the difference between prevailing pay and census pay more than 2 standard-deviations above average; Group B LCOs are between 1 and 2 standard deviations above average; Group C, within one standard deviation; Group D, between 1 and 2 standard-deviations below average; and Group E is more than one standard deviation below average.

3. COMPARISONS BETWEEN THE 1990 AND 2000 NRFU

Table 3-1 describes key differences between the 1990 and 2000 NRFUs. The 2000 figures are derived from our current analysis that includes all but one of the 520 local census offices (LCOs). To facilitate the comparisons, all 1990 pay figures are multiplied by 1.347 (the ratio of average local pay in 2000 to average local pay in 1990) so that 1990 local pay equals 2000 local pay.

Table 3-1. Differences in pay and performance between the 1990 and 2000 NRFU

	LCOs in group	Local pay	Census pay	Pay ratio	Pay Difference		Retention per week	Weeks open
					Mean	Std. Dev.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1990	269	$15.34	$ 8.83	.576	$6.51	$1.74	.738	9.72
2000	519	$15.34	$12.17	.793	$3.17	$2.56	.905	7.19
% difference		0.0%	37.8%	37.8%	-51.3%	47.3%	22.6%	-26.0%

Note: In 1990 local pay averaged $11.39 in 1990 dollars. All 1990 pay figures were multiplied by 1.347 to facilitate the comparison with 2000 figures. 1990 retention reflects the average weekly permanent separation rate of enumerators starting in week 1 and 2 over weeks 1 through 5. In contrast, the 2000 figure counts the fraction of enumerators employed in week 2 who did not permanently separate in that week. Week 2 separations were used for 2000 because the NRFU was completed so rapidly that many enumerators were being released by the end of the third week.

Using comparable local pay figures, column 3 shows that census pay was 37.8 percent higher in 2000 than in 1990. Column 5 shows that the difference between local and census pay narrowed by 51.3 percent. Column 6 shows that the variation around the mean increased. This result was expected because the 2000 pay increases were not based on a fixed dollar amount but were proportional to local pay. As a result, there was a much wider range of pay rates in 2000. Column 7 shows that the pay increase was associated with an increase in retention of 22.6 percent. As shown in column 8, this increase, together with increased frontloading, facilitated the completion of the 2000 NRFU in 7.19 weeks in an average LCO. The 2.53 week reduction in average completion time represents a 26.0 percent reduction relative to the time it took to complete the 1990 NRFU.

These results clearly show the following:

- The Census Bureau completed the NRFU much more rapidly in 2000 than 1990.
- Higher pay in 2000 was associated with substantial increases in enumerator retention.
- Differences between local pay and census pay were reduced by more than 50 percent, but there was still considerable variation in those differences across LCOs.

Not shown in the table is that the pay-setting procedures narrowed the ratio between local and census pay more than it narrowed the arithmetic difference. However, there was still considerable variation across LCOs in that ratio—the standard deviation around the mean ratio was .115. This difference persisted because our measure of prevailing pay reflected pay of local firms, not local residents. Thus, setting competitive rates required increasing pay in many LCOs within commuting distance of large, high-wage cities. Pay was also increased in rural areas where pay in nearby LCOs was much higher and in areas with large seasonal fluctuations in employment, such as resorts and some farming communities.

Finally, it is noteworthy that no pay increases were needed during the 2000 NRFU operation (though there were pay increases during recruiting). In contrast, a large pay increase was made in many LCOs during the 1990 NRFU operation to reduce the unanticipated high rates of enumerator attrition.

4. SOURCES OF VARIATION ACROSS LCOs IN COMPLETING THE 2000 NRFU

This section examines factors that explain why the time it took to complete the 2000 NRFU varied across the local census offices (LCOs). In order to examine these factors, we group the LCOs by how much progress they made by the end of the third full week of NRFU operations. Group 1 was one standard deviation or more above average. Group 2 was less than one standard deviation above average. Group 3 was less than one standard deviation below average. Group 4 was one standard deviation or more below average.

The LCOs in our sample completed almost 43 million cases. As shown on line 3 of Table 4-1, 57.0 percent of the cases were complete by the end of the third week. However, there was considerable variation in the rate of progress. By the end of the third week, LCOs in Group 1 completed 77.1 percent of their cases, while LCOs in Group 4 completed only 38.5 percent of their cases. (In this discussion we mainly focus on the differences at the extremes of the distribution, Group 1 versus Group 4, but evidence for Group 2 and Group 3 enumerators is consistent with the patterns described.)

Overall, an average LCO completed 99.4 percent of its cases by the end of week 7, and as shown on line 5, took 6.69 weeks on average to complete 95 percent of its cases. It took 5.49 weeks on average for the Group 1 LCOs to reach the 95 percent point, compared to 7.55 weeks for Group 4 LCOs to reach the 95 percent point. However, it is noteworthy that even the LCOs at the **bottom** of the 2000 distribution reached the 95 percent completion point about 1.5 weeks faster than the local offices at the **top** of the 1990 distribution.

4.1 The Effect of Frontloading

One of our most important findings is that the difference in the pace of operations was not due to variation in when operations were supposed to start or the ratio of enumerators planned to be at work during the first week relative to cases to complete. There was almost no variation across LCOs in when the first case was completed, but there were large variations in the ratio of number of enumerators at work in the first week to cases to complete.

Table 4-1. Cross-LCO differences in NRFU performance

		Group 1	Group 2	Group 3	Group 4	Total
1.	LCOs in group	81	166	193	79	519
2.	% of total	15.6%	32.0%	37.2%	15.2%	100.0%
	A. Cases completed					
3.	End of 3rd week	77.1%	64.1%	51.9%	38.5%	57.0%
4.	During 2nd week	29.1%	24.2%	19.6%	14.4%	21.5%
5.	Weeks to 95% completion point	5.49	6.41	6.81	7.55	6.69
6.	Weeks to 90% of enumerators start work	2.56	3.93	4.86	5.90	4.75
	B. Continuation rate					
7	Week 2	.847	.870	.869	.872	.866
8.	Week 4	.546	.697	.767	.811	.723
	C. Separation rate					
9.	Week 2	9.5%	6.7%	5.5%	3.9%	6.2%
10.	Week 4	25.2%	17.4%	11.8%	8.1%	14.8%
	D. Ratio of total cases to:					
11.	Total hours week 1	3.87	4.51	5.12	6.71	4.88
12.	Total hours week 3	4.54	4.49	4.67	5.29	4.68
	E. Ratio of total cases to:					
13.	Enumerators week 1	136	165	197	277	183
14.	Enumerators week 3	199	169	170	185	176
	F. Average per enumerator					
15.	Cases	79.3	84.4	82.8	80.4	81.8
16.	Cases/week (week 3)	26.4	27.1	25.7	24.1	26.1
17.	Cases/week (all weeks)	23.1	22.0	20.0	20.6	21.5
18.	Cases/hour	1.397	1.127	1.076	1.105	1.112
19.	Hours/week	16.5	19.5	18.6	18.6	19.3
20.	Weeks	3.43	3.84	4.14	3.90	3.81
21.	Maximum enumerators at work in any week	672	691	692	667	645
22.	Week with maximum enumerators	2	3	3	4	3
23.	Ratio maximum enumerators to target hires	138%	122%	117%	109%	113%

The most direct evidence that the week 1 enumerators to cases ratio was the key to rapidly completing the NRFU comes from line 13 of Table 4-1. Line 13 shows that in week 1 there was one enumerator for each 136 cases to be completed in Group 1 LCOs, but only one enumerator for each 277 cases to be completed in Group 4 LCOs.

For enumerators in Group 1 and Group 4 LCOs, the ratio of total cases to total *hours* worked in week 1 is quite similar to the ratio of total cases to the total *number* of enumerators at work. That these ratios are similar suggests that enumerators in LCOs in both Groups 1 and 4 started at the same point in week 1, as was planned to happen. This eliminates the possibility that differences in starting times explain the differences in performance between the two groups.

Additional evidence that the LCO groupings in Table 4-1 reflect differences in cases completed per unit of time (rather than differences in start date) comes from line 4, which shows that the variation in performance across the four groups is almost the same in week 2 alone as in weeks 1 through 3 together. More specifically, in week 2, more than twice the percent of cases were completed by Group 1 LCOs as were completed by Group 4 LCOs. This is the case even though (a) Group 1 LCOs had completed about 25 percent of their cases in week 1 compared to about half that proportion in Group 4, and (b) completing cases becomes progressively more difficult as the NRFU goes on.

Line 21 of Table 4-1 shows that there was not a lot of variation in the maximum number of enumerators at work in any one week, but line 22 shows that there was substantial variation in which week the maximum was reached. Of greatest importance, line 23 shows that there was substantial variation in the ratio of maximum enumerators at work in any week to frontloading (week 1) targets. Indeed, the fraction of enumerators at work in Group 1 LCOs peaked at 138 percent of their targets in week 2, while the fraction in Group 4 LCOs peaked at only 109 percent of their targets, and did not do so until week 4. Although not shown in the table, Group 1 LCOs substantially exceeded their targets in week 1, but Group 4 LCOs did not reach their targets until week 3.

Line 14 of Table 4-1 shows that the ratio of cases to complete to enumerators at work in week 3 were comparable between Group 1 and Group 4 LCOs, but the ratio for Group 4 was still *well above the level reached by the Group 1 LCOs in week 1.* This is powerful evidence that Group 4 LCOs were slow to build up the number of enumerators at work, did not achieve the target amount of frontloading in the first week, and, therefore, ended up completing much lower percentages of cases by the end of week 3.

Additional information about the rate at which enumerators were put in place comes from line 6, which shows that 90 percent of all the enumerators that ever worked in Group 1 LCOs were at work after only 2.56 weeks, while it took 5.90 weeks for 90 percent of all Group 4 enumerators to start work.

Finally, the figures in lines 15 through 20 of Table 4-1 show that there was some difference in the performance of individual enumerators across the LCOs in different groups. Most of these differences were in the direction of speeding completion of the work in Group 1 LCOs and slowing completion of work in Group 4 LCOs. However, these differences were small relative to differences in the number of enumerators at work in week 1, and only explain a small fraction of the difference in the percent of cases completed by the end of week 3.

One difference is that, on average, enumerators in Group 4 worked slightly fewer hours per week than enumerators in other groups (see line 19). However, the largest differences are that Group 1 enumerators were substantially more productive per hour worked than Group 2 enumerators, and Group 2 enumerators were more productive than Group 3 enumerators (line 18). These differences in productivity could stem from many sources. For example, management could be more effective in Group 1 LCOs or factors outside of the Census Bureau's control could have made it easier to complete cases more rapidly in Group 1 LCOs. Sorting out the underlying sources of variation is a major focus of the rest of this report.

In summary, having fewer enumerators at work than planned in weeks 1 through 3 was the primary factor associated with Group 4 LCOs needing the most time to complete the NRFU. In contrast, progress would have been only a little faster in Group 4 LCOs if the number of hours worked per week and cases completed per hour were equal to those in Group 1 LCOs.

Modest cost increases also were likely associated with LCOs in Group 4 not getting a high percentage of their enumerators working during the first few weeks. Cost increases would be expected because enumerators become more effective as they gain experience, especially over the first few weeks of work, and delays in enumerators' start dates reduce the average level of experience and average productivity.

Significant cost saving would have occurred had all the Group 4 enumerators who ever worked started closer to week 1. This is because these LCOs would have had to hire, train, and supervise fewer enumerators overall. Indeed, our earlier studies using 1990 NRFU data showed that increasing speed can be quite costly due to the need to train and supervise more enumerators than otherwise would be needed. Originally we planned to document the differences in productivity and cost associated with differences in the 2000 NRFU frontloading patterns, but we lacked the time to complete this highly complex and time-consuming task for inclusion in this report.

4.2 The Effect of Retention

Another important finding derived from Table 4-1 is that enumerator retention was high among LCOs in all four groups. Line 7 shows that the number of enumerators working in week 2 who continued to work in week 3 was close to the average ratio of .866 across all groups, and far higher than the 1990 continuation rate, which was about .650. Thus, in sharp contrast to 1990, failure to retain enumerators had virtually no bearing on how quickly LCOs completed their assigned work in 2000.

The week 2 continuation rate was highest in Group 4 and lowest in Group 1. However, lines 8 and 10 suggest that the 2000 continuation rates fall as the NRFU progresses, mainly because progress was so rapid that many enumerators were no longer needed by the end of the fourth week. Among Group 1 enumerators in week 4 when 92.0 percent of cases were completed, roughly 45 percent did not continue to work in week 5, and 25.2 percent left permanently. Among Group 4 enumerators at work in week 4 when 58 percent of cases were completed, 18 percent did not continue to work in week 5, and only 8.1 percent left permanently.

As will be discussed in considerable detail in subsequent sections, the speed with which the NRFU was completed made it difficult to distinguish between separations by enumerators the crew leaders wanted to retain versus separations by enumerators who were no longer needed by their crew leaders. As a result, it was difficult to determine the effect of pay and other factors on “unwanted” separations or the effect of unwanted separations on the speed of completion.

5. CHARACTERISTICS ASSOCIATED WITH CROSS-LCO VARIATION IN COMPLETING THE 2000 NRFU

Table 5-1 describes key characteristics that might be associated with differences in the rate at which cases were completed across the LCOs during the 2000 NRFU. Four different types of characteristics are included in the table—characteristics of the area, census practices, pay, and the enumerators. The table uses the same LCO groupings as Table 4-1. Thus, Group 1 includes LCOs with a one standard deviation above average completion rates by the end of the third week, etc.

Panel A: Area Characteristics suggests that low completion rates are associated with high-density, high-income LCOs, traits found in and near large cities, and that high completion rates are associated with low-density, low-income LCOs. However, the area employment levels were especially high in the LCOs completing the most cases.[4] Our analysis suggests that this is a result of there being many LCOs in major cities, especially in the New York and Los Angeles metropolitan areas. In contrast, many of the LCOs in Group 1 are geographically large and located in less urban areas of the West.

The results displayed in Panel A for 2000 are consistent with the results for 1990 discussed in Section 2. In 1990, longer completion times were associated with high density, relatively high income areas. The same general pattern was found in 2000.

Panel B: Recruiting/Hiring/Management Characteristics shows that despite having high employment levels, the areas making quickest progress had fewer cases to complete (relative to larger scale efforts), line 7, and were authorized to hire slightly more enumerators per case than other areas, line 9. It is our understanding that the differences in workloads and targets largely reflect differences in the degree of population dispersion and on expected difficulty in completing cases. In areas of the United States where most residents live in rural areas, LCOs tended to be large geographically, but included relatively small populations. Also, the distances that need to be covered in rural areas typically make it more time-consuming for enumerators to travel from one residence to another.

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[4] Ideally we would have liked to examine the effect of characteristics within individual LCOs on completion time. However, all our area data in section A (and local pay in section C) are derived from county-level statistics. In most cases, county borders and LCO borders coincided. Thus, usually our area figures reflected LCO characteristics. However, in major cities there was a tendency for several LCOs to be located in a single county. In such cases we used identical county-level statistics for each LCO in the same county. The number of different LCOs in a single county in a major city depended both on population density and the geographic size of the county. In other areas, where an LCO included all of one or more counties as well as parts of other counties, we prorated the area statistics across the counties divided up among one or more LCOs. For example, if a county was split among three LCOs, one-third of the employment of that county would be added to the employment of the other counties included in each of the three LCOs.

Table 5-1. Cross-LCO differences associated with differences in NRFU performance

		Group 1	Group 2	Group 3	Group 4	Total
1.	LCOs in group	81	166	193	79	519
2.	% of total	15.6%	32.0%	37.2%	15.2%	100.0%
3.	Cases completed by 3rd week	77.1%	64.1%	51.9%	38.5%	57.0%
	A. Area Characteristics					
4.	Employment	845,354	499,082	496,233	512,979	551,758
5.	Density (people per sq. mile)	935	1,149	1,181	1,413	1,170
6.	Per capita income	17,075	17,670	19,124	19,635	17,950
	B. Recruiting/Hiring/Management Characteristics					
7.	Cases	63,355	76,981	82,786	83,834	77,896
8.	Recruiting target	4,162	4,788	5,084	5,174	4,860
9.	Cases/recruiting target	15.22	16.08	16.28	16.20	16.03
10.	Applicants	7,121	7,110	7,120	6,798	6,968
11.	Ratio (Feb) appl/recruiting target	1.327	1.046	.930	.791	.984
12.	Enumerators	802	919	1,011	1,044	942
13.	% LCOs with LCOM switch	8.0%	9.1%	12.1%	20.3%	11.0%
	C. Pay Characteristics					
14.	Census pay	$11.50	$12.07	$12.40	$12.52	$12.17
15.	Local pay	$14.11	$14.85	$15.76	$16.59	$15.34
16.	Difference (local-census)	$2.61	$2.78	$3.36	$4.07	$3.04
17.	Ratio (local/census)	.824	.825	.800	.764	.791
	D. Applicant/Enumerator Characteristics					
	Fraction with test scores > 90					
18a.	Applicants	.434	.452	.445	.436	.444
18b.	Enumerators	.637	.629	.580	.539	.597

Perhaps of even greater importance, panel B shows that LCOs in each completion group recruited about the same number of applicants (line 10), despite having large differences in targets. By the end of February, Group 1 LCOs exceeded their targets by 32.7 percent, Group 2 LCOs exceeded targets by 4.6 percent, but Group 3 LCOs fell short of targets by 7.0 percent, and Group 4 LCOs fell short of targets by 28.9 percent (see line 11).

It is possible that where recruiting progress was slow, recruiting was simply more difficult or resources were not as readily available. However, evidence in Table 5-1 (and analysis in our recently completed recruiting study) suggests that differences in performance were related to differences in management behavior at both the region and local level.

It is particularly noteworthy that turnover among LCO managers (LCOMs) in the 5 months prior to the start of the NRFU was strongly associated both with slow recruiting performance and slow completion of the NRFU itself. Line 13 shows that 20.3 percent of the Group 4 LCOs had at least one LCOM leave, compared to only 8.0 percent of the Group 1 LCOMs.

The sharp difference between LCOM turnover in the LCOs where completion was slowest versus other LCOs suggests that often it was the poor performance of the LCOM that placed the LCO in Group 4. However, the modest levels of LCOM turnover in other groups suggest that LCOM turnover does not invariably lead to longer completion times.

Information we obtained from interviewing local and headquarter staff reinforces this view. The impression we were given is that (1) LCOMs usually quit or were fired because they were unable to perform well, and straightening out performance in those LCOs usually was especially difficult; (2) in some cases an effective LCOM was rapidly replaced by an effective substitute; and (3) there were cases where performance suffered after an effective LCOM left (for personal reasons) because it took time to find an adequate substitute or for the substitute to perform well.

What is harder to judge is the extent to which factors outside of the LCOMs' control contributed to their performance. In the next section, we use multiple regression analysis to help address this question.

Line 15 of **Panel C: Pay Characteristics** shows that progress was fastest in LCOs with the lowest levels of local pay, and local pay was successively higher as progress rates declined. A similar but somewhat weaker pattern occurred for differences in per capita income and population density.

Line 14 shows that census pay also increases as we move across the table from the groups with highest completion rates to lowest completion rates, but the increases are less than proportional to the increases in local pay. As a result, the dollar gap in pay widens substantially across the completion groups. The ratio of census pay to local pay is substantially lower in the Group 4 LCOs, than in the Group 3 LCOs; and in the Group 3 LCOs, than in the Group 2 and 1 LCOs, but the ratios are about the same in the Group 1 and Group 2 LCOs.

These patterns suggest that differences in relative pay may explain some of the differences in performance, particularly the relatively poor performance of the Group 4 LCOs relative to Group 3 LCOs and the Group 3 LCOs relative to those in Groups 1 and 2. Significantly, the pay effects seem to diminish as the ratio of census pay to local pay approached .825. This result is consistent with our earlier analysis of the 1990 NRFU that suggests the retention improvements associated with high pay ratios diminish as the ratios increase.

However, a key difference with earlier results is that there is no obvious association between low census pay (relative to local pay) and factors that would be expected to adversely affect performance. For example, Table 4-1 does not show a connection between speed and high retention (even though this association was clearly evident in the 1990 NRFU and 2000 dress rehearsals).

Two possible data-related explanations for this lack of statistical association are that (1) our measure of retention (even in week 1) does not reflect "unwanted" separations and (2) our measure of relative pay may not adequately reflect differences between census pay and locally competitive pay. Put more simply, key relationships observed in earlier analyses may be obscured because reductions in "unwanted" separations are balanced by increases in "wanted" separations, or because we have eliminated most of the variation between census pay and locally competitive pay.

A third explanation, which we discuss in detail subsequently, is that pay was set sufficiently high to generate a huge recruit pool of highly qualified applicants; as a result virtually all enumerators were able to perform well and were committed to remaining at their jobs until they were no longer

needed. That pay ratios were so similar across Group 1 and 2 LCOs is consistent with the view that when pay is above some threshold, differences in performance no longer are associated with differences in pay.

Two final key points are that (1) even if low relative pay adversely affected enumerator performance on the job, that by itself would not explain the variation in the number of enumerators at work in week 1, and (2) differences in frontloading is the primary determinant of how quickly the NRFU was completed in different LCOs. However, relative pay might affect offer acceptance rates, and slowness in getting acceptances could slow the rate at which enumerators were put to work. This possibility is discussed below. Also, we attempt to determine what factors outside of the control of census managers affected performance using regression analysis in subsequent sections.

Panel D: Applicant versus Enumerator Characteristics shows the relationship between test scores and performance. Lines 18a and 18b show that there was little difference in the fraction of **applicants** with test scores above 90 percent, but large differences in the fraction of **enumerators** with test scores above 90 percent. High test scores had a strong positive effect on enumerator performance in 1990, and the results in section 7 of this report suggest that they had a positive, but much weaker effect in 2000. Thus, the differences in test scores account for only a small fraction of the difference in 2000 performance.

However, the difference in enumerator test scores between Group 1 LCOs and Group 4 LCOs might reflect differences in the way Group 4 managers applied the rules with respect to hiring local area applicants in order of test score. Those differences also might have been linked to indifference about meeting frontloading targets. Initially, we believed that the evidence was consistent with these hypotheses. But, Ed Funkhouser, one of our expert reviewers, drew our attention to the fact that the Group 4 LCOs hired 19.0 percent of the applicants with test scores above 90 percent, compared to Group 1 LCOs, which hired only 16.5 percent of their comparable applicants. The reason Group 4 LCOs ended up hiring a higher fraction of their high-scoring pool, but ended up with a smaller proportion of enumerators scoring above 90 percent, is that the Group 4 LCOs had more cases to complete than Group 1 LCOs, and they had a much smaller pool of high scoring applicants.

Nevertheless, the fact remains that the Group 4 LCOs took much *longer* than Group 1 LCOs to build up the number of enumerators at work on the NRFU. Thus, we are still left with two plausible explanations for these delays. The first is that Group 4 LCOs did not put sufficient effort into hiring the

needed number of enumerators *prior to the start of operations*. The second is that it was much harder for Group 4 LCOs to contact applicants and/or to get them to accept job offers once contacted.

Unfortunately, we cannot directly test the above hypotheses because we lack data on the number of offers made, the timing of offers, and which applicants offered enumerator positions turned down those offers, or did not show up for training. While we can only speculate on the importance of the two hypotheses, the fact that relative pay was lower in groups with low test scores opens up the possibility that refusals were strongly affected by relative pay. If this was the case, it could explain why fewer enumerators were put to work in week 1.

On the other hand, the strong association between high LCOM turnover and inability to meet frontloading requirements opens up the possibility that local management factors strongly influenced performance. The possibility that management ability or discretion is a key factor is strengthened by evidence that relatively low pay and area characteristics explain only a small amount of the differences in the speed with which recruiting goals were met.

This speculation raises fundamental questions about why frontloading varied across LCOs:

- Did some LCO managers disregard the basic plan? If so, was the decision made at the local or regional level?
- Were some LCO managers unable to follow the basic plan because conditions outside of their control made following the plan impossible? If so, what were those conditions?

In the succeeding analysis we will attempt to address the second question. However, it is important to keep the following in mind:

- Virtually all LCOs met the key performance criterion of completing the NRFU within 9 weeks.
- We did not detect any systematic differences in retention across LCOs with different completion rates. This implies that, although there were differences in relative pay, pay was set high enough to ensure that retention would be uniformly high.
- The primary factor determining completion rates was the degree of frontloading (the ratio of enumerators at work the first week to cases to complete). Thus, explaining variation in completion rates narrows down to explaining variation in frontloading.

- Differences in relative pay might explain why some LCOs were slow to meet hiring targets through an effect on acceptance rates. However, we lacked the data needed to test this hypothesis.

In short, our analysis of Tables 4-1 and 5-1 suggests that the basic plan for executing the NRFU was sound. That is, all key performance criteria were able to be met once wages were increased to at least 75 percent of local levels, and frontload was increased to the point that the number of enumerators working in the initial stages equaled at least 150 percent of the number of enumerators needed to complete the bulk of the work in 6 weeks if there was no attrition.

The analysis in this section also shows that LCOs who were able to attain higher levels of frontloading than required completed the NRFU even more quickly. What we cannot say based on the evidence developed so far is why the amount of frontloading varied across the LCOs.

6. REGRESSION ANALYSIS OF FACTORS ASSOCIATED WITH QUICK COMPLETION OF THE 2000 NRFU

In this section we use regression analysis to:

- More rigorously assess the **independent** effect of the factors discussed in Section 5 on how quickly the NRFU was completed in different local census offices (LCOs).
- Examine the extent to which performance was influenced by:
  - Factors outside the control of the Census Bureau;
  - Pay and other factors set at the headquarters level; and
  - Regional and local management.

Table 6-1 displays a regression using as the dependent variable the percent of the NRFU completed by the end of the third week of field operations in each of 510 LCOs. (The Window Rock, Arizona, and all nine Puerto Rico LCOs were excluded because we lacked some information about these areas.) The independent variables fall into six categories—the characteristics of (1) areas, (2) enumerators, (3) census pay, (4) NRFU management, and (5) NRFU performance, plus (6) dummies for census regions.

The variables in Table 6-1 are ordered by the size of their effect on the dependent variable based on use of the coefficient for 0/1 variables (the regional dummies plus whether the LCOM left) and the coefficient times twice the standard deviation for continuous variables. In keeping with expectations derived from Table 5-1, the ratio of total cases to enumerators at work in week 1 has by far the greatest effect on the percentage of cases completed by the end of week 3. LCOs with relatively few enumerators per case to complete had only one enumerator for each 161 cases, while LCOs with many enumerators per case had one enumerator for each 100 cases. Those LCOs that had 61 more cases to complete per enumerator completed only 48 percent of their cases on average by the end of week 3, compared to 65 percent of the cases in those LCOs with more enumerators per case to complete.

An LCO being located in the Denver region has the next strongest effect. This effect is consistent with the Denver regional office taking a number of steps to facilitate quick completion of the NRFU, including making sure LCOs had high levels of frontloading and quickly put to work all

Table 6-1. Regression describing the effect of various factors on percent of cases completed by end of the third week of the NRFU

		Specification-1			Standard	Variable	Effect on %
		Coefficient	"t" Statistics	Mean	deviation	type	cases completed
		(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable						
	% Cases completed weeks 1-3			0.565	0.133		
	Independent Variables						
	Intercept	0.8102	4.80				
1.	Ratio of cases to enumerators at work week 1	-0.002498	-18.11	130.55	30.68	C	-0.1533
2.	Denver Region	0.107	6.64	0.07	0.26	O/1	0.1066
3.	Local pay	-0.0106	-6.52	15.34	3.89	C	-0.0826
4.	Atlanta Region	0.069	5.22	0.11	0.31	O/1	0.0692
5.	Enumerators' average test score	0.0100	3.51	89.82	2.70	C	0.0541
6.	Applicants' average test score	-0.0084	-2.59	85.60	2.77	C	-0.0465
7.	Area employment	3.066E-08	4.19	551,758	719,898	C	0.0441
8.	Dallas Region	0.014	0.98	0.09	0.29	O/1	0.0278
9.	Ratio of applicants in February to recruiting target	0.0288	2.40	1.00	0.43	C	0.0245
10.	Los Angeles Region	0.024	1.32	0.08	0.27	O/1	0.0245
11.	Cases per hour	0.0187	2.95	1.23	0.60	C	0.0224
12.	LCOM turnover	-0.0143	-1.24	0.11	0.31	O/1	-0.0143
13.	Area population density	-2.38E-06	-0.79	1,170	1,786	C	-0.0085
14.	Seattle Region	0.003	0.21	0.07	0.26	O/1	0.0063
15.	Cases to complete	-1.31E-07	-0.69	83,004	23,426	C	-0.0062
16.	Census pay rate	-0.0008	-0.29	12.16	2.50	C	-0.0042
	Adjusted R Square	0.6389					

Note: Variable type C=continuous; 0/1=bivariate

Column 6 shows the effect on % cases completed of a two standard-deviation change in continuous variables and a change equal to the coefficient for 0/1 variables; 0/1 variable names are underlined and columns 5 and 6 values shaded.

The regressions include 510 LCOs. The Window Rock, AZ, and 9 Puerto Rico LCOs were dropped due to the lack of data.

enumerators used at any point. In third place, is local pay levels. In this case, the greater the pay, the smaller the percentage of cases is completed by the end of week 3. This reinforces the view that completing the NRFU was more difficult in high wage areas, primarily large cities and some suburbs. Importantly, population density, which is correlated with local wages, has only a small negative effect on cases completed. This suggests that any high wage area is likely to complete the NRFU relatively slowly.

An LCO being in the Atlanta region is in fourth place, but the effect is considerably less than that for local pay. The average test scores of enumerators and applicants are in fifth and sixth place, respectively, but the effects are in opposite directions. The enumerator test score result is highly consistent with evidence presented in Section 5. Evidence that will be presented in the next section suggests that variation in the test scores in the range observed in 2000 had little effect on productivity. Thus, we regard the test score result to be more an indicator of an LCO having difficulty promptly hiring enumerators, than having more productive enumerators.

In contrast, the applicant test score result was not obvious from the analysis described in Section 5. This suggests that controlling for some other characteristics was crucial to producing this unexpected result. Our view is that in this regression, high test scores of applicants are an indicator of the characteristics of people in a given area and unrelated to recruiting performance. Thus, it indicates that areas where the population scores well on tests are also areas where completing the NRFU is more difficult.

Area employment in the LCO is in seventh place, a result highly consistent with the tabulations discussed in Section 5. The remaining variables have relatively small effects and are statistically insignificant, except for the ratio of applicants recruited by the end of February to the LCO's recruiting target, and cases per hour. We regard the applicant/recruiting-target ratio as an indicator of management effectiveness (given that other factors that affect recruiting are held constant). That its effect on cases completed is fairly strong provides another indication that variation in management performance contributed importantly to variation in completion time.

The primary purpose of the specification used in Table 6-1 is to provide an indication of which variables had large, independent effects on performance. In particular, we wanted to test whether the number of enumerators at work in week 1 was the most important determinant of how quickly the NRFU was completed, even after controlling for a wide range of additional variables. We also tested the effect of a large number of variables, which we did not include in the table because we found them to

have little effect on cases completed with this or any other specification. These variables include regional dummies for Boston, New York, Charlotte, and Kansas City, as well as the retention rate in week 1.

In Table 6-2 we remove the applicant/recruiting-target ratio but leave the Table 6-1 specification otherwise unchanged. Doing this is likely to provide a better indicator of the importance of each variable because we know from our recruiting study that success in recruiting was strongly affected by a number of factors included in the initial specification, such as relative pay, LCOM turnover, and applicant test scores. However, we believe that changes in the regression coefficients after removing the applicant/recruiting-target ratio also indicate the importance of management practices because some of the explanatory power of this variable captures otherwise unmeasured factors, especially management quality.

The differences between the coefficients, using the same specification with and without the applicant/recruiting-target ratio, show that the explanatory power of a number of variables was substantially weakened by the inclusion of that variable. The increase in the coefficients for the Seattle region and number of cases is particularly large, but not statistically significant at the .05 level. The increases are also large for the test scores.

In Table 6-3 we remove the ratio of cases to enumerators at work in week 1 (and add the Chicago region dummy variable to specification 2 and 3). Removing the cases per enumerator ratio provides a much better indication of the importance of the variables remaining in the specification. This ratio is highly correlated with cases completed, but it is more of a proxy for the dependent variable than a variable describing exogenous factors or factors that indicate the effect of pay or management practices. Thus, it is hardly surprising that omitting the cases per enumerator ratio is associated with a reduction in the regression's R-square from .635 to .406.

With the cases per enumerator ratio removed, the variable that has the largest effect on cases completed is the Denver region dummy. The increase in the effect of this variable is a strong indication that the fast completion rate in the Denver region was *a direct result of having many enumerators at work in week 1 relative to the total number of cases to be completed*. Moreover, interviews with census officials make us confident that the increase in this region was primarily due to specific management behaviors rather than factors outside of management control that made it easier to achieve a high ratio. Table 6-4 presents the regressions without the region variables.

Table 6-2. Percent cases-completed regression with/without the February applicants variable

Dependent Variable

% Cases completed week 3 — Std-Dev = 0.133 — Mean =.565

		Specification 2 (applicant/target ratio removed)		Specification 1		Effect of removing applicants on: coefficient	Effects on % cases completed without applicants	Rank order using specification 1
		Coefficient	"t" Statistics	Coefficient	"t" Statistics			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Independent Variables							
	Intercept	0.8622	5.11	0.810	4.80	6.4%		
1.	Ratio of cases to enumerators at work week 1	-0.0025	-17.62	-0.002498	-18.11	1.6%	-0.150	1
2.	Denver Region	0.120	7.91	0.107	6.64	12.7%	0.120	2
3.	Local pay	-0.0116	-7.28	-0.0106	-6.52	9.5%	-0.090	3
4.	Enumerators' average test score	0.0128	4.90	0.0100	3.51	28.0%	0.069	5
5.	Atlanta Region	0.064	4.81	0.069	5.22	-8.0%	0.064	4
6.	Applicants' average test score	-0.0114	-3.77	-0.0084	-2.59	35.5%	-0.063	6
7.	Area employment	3.11E-08	4.08	3.07E-08	4.19	1.5%	0.045	7
8.	Los Angeles Region	0.023	1.19	0.024	1.32	-7.6%	0.023	10
9.	Cases per hour	0.0179	2.81	0.0187	2.95	-4.0%	0.022	11
10.	LCOM turnover	-0.0169	-1.45	-0.0143	-1.24	17.6%	-0.017	12
11.	Dallas Region	0.017	1.17	0.014	0.98	20.3%	0.017	8
12.	Seattle Region	0.015	1.02	0.003	0.21	362.1%	0.015	14
13.	Cases to complete	-2.65E-07	-1.39	-1.31E-07	-0.69	101.8%	-0.012	15
14.	Area population density	-2.49E-06	-0.82	-2.38E-06	-0.79	4.6%	-0.009	13
15.	Census pay rate	9.56E-05	0.03	-0.0008	-0.29	-111.3%	0.000	16
16.	Ratio of applicants in February to recruiting target	--	--	0.0288	2.40			9
	Adjusted R Square	0.6347		0.6389		-0.7%		

Note: Column 6 shows the effect on % cases completed of a two standard-deviation change in continuous variables; and a change equal to the coefficient for 0/1 variables; 0/1 variable names are underlined and column 6 values shaded.

Table 6-3. Percent cases-completed regression with/without the week 1 enumerators variable

Dependent Variable

% Cases completed week 3 — Std-Dev = 0.133 — Mean =.565

		Specification 3 (cases per enumerator ratio Removed)		Specification 2 (with Chicago added)		Effect of removing enumerators on: coefficient	Effects on % cases completed without enumerators	Rank order Using specification 2
		Coefficient	"t" Statistics	Coefficient	"t" Statistics			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Independent Variables							
	Intercept	0.3533	1.67	0.8622	5.11	-59.0%		
1.	Denver Region	0.158	8.23	0.120	7.91	31.4%	-0.1558	2
2.	Local pay	-0.0121	-5.92	-0.0116	-7.28	3.8%	0.1202	3
3.	Enumerators' average test score	0.0169	5.08	0.0128	4.90	31.6%	-0.0904	4
4.	Chicago Region	-0.079	-4.48	-0.002	-0.16	3280.1%	0.0693	15
5.	Los Angeles Region	0.074	3.08	0.023	1.19	226.4%	0.0636	8
6.	Cases to complete	-1.55E-06	-6.90	-2.65E-07	-1.39	483.0%	-0.0630	9
7.	Applicants' average test score	-0.0123	-3.21	-0.0114	-3.77	8.6%	0.0448	6
8.	Atlanta Region	0.059	3.50	0.064	4.81	-7.3%	0.0226	5
9.	Area employment	3.01E-08	3.10	3.11E-08	4.08	-3.2%	0.0215	7
10.	LCOM turnover	-0.0368	-2.49	-0.0169	-1.45	118.0%	-0.0169	10
11.	Seattle Region	0.032	1.75	0.015	1.02	117.3%	0.0167	12
12.	Dallas Region	0.030	1.67	0.017	1.17	82.2%	0.0146	11
13.	Area population density	-4.75E-06	-1.23	-2.49E-06	-0.82	91.1%	-0.0124	14
14.	Census pay rate	0.003	0.81	9.56E-05	0.03	3038.4%	-0.0089	16
15.	Cases per hour	-0.0003	-0.03	0.0179	2.81	-101.4%	0.0005	13
16.	Ratio of cases to enumerators at work week 1	--	--	-0.0025	-17.62			1
	Adjusted R Square	0.4058		0.6347		-36.1%		

Note: The Chicago region variable was added to the above specifications because it is highly significant when the enumerator variable is dropped.

Column 6 shows the effect on % cases completed of a two standard deviation change in continuous variables; and a change equal to the coefficient for 0/1 variables; 0/1 variable names are underlined and column 6 values shaded.

Table 6-4. Percent cases-completed regression with/without the region variables

Dependent Variable

% Cases completed week 3 — Std-Dev = 0.133 — Mean =.0565

		Specification-4 (without regions)		Specification-3 (with enumerators)		Effect of removing regions on: coefficient	Effects on % cases completed without regions	Rank order with region
		Coefficient	"t" Statistics	Coefficient	"t" Statistics			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Independent Variables							
	Intercept	0.6776	3.24	0.3533	1.67	91.8%		
1.	Enumerators' average test score	0.0232	6.60	0.0169	5.08	37.3%	0.0627	3
2.	Applicants' average test score	-0.0219	-5.72	-0.0123	-3.21	77.7%	0.0608	7
3.	Local pay	-0.0127	-5.86	-0.0121	-5.92	5.7%	0.0496	2
4.	Cases to complete	-1.58E-06	-6.77	-1.55E-06	-6.90	2.5%	0.0371	6
5.	LCOM turnover	-0.0303	-1.87	-0.0368	-2.49	-17.5%	0.0303	10
6.	Area employment	3.91E-08	4.57	3.01E-08	3.10	29.7%	0.0281	9
7.	Area population density	-1.25E-05	-3.01	-4.75E-06	-1.23	162.5%	0.0223	13
8.	Cases per hour	0.0068	0.80	-0.0003	-0.03	-2816.7%	0.0041	15
9.	Census pay rate	-0.000246	-0.06	0.003	0.81	-108.2%	0.0006	14
	Adjusted R Square	0.2724		0.4058		-32.9%		

Note: Regional variables were included in specification 3, but coefficients are not shown in this table.

Column 6 shows the effect on % cases completed of a two standard deviation change in continuous variables; and a change equal to the coefficient for 0/1 variables; 0/1 variable names are underlined and column 6 values shaded.

7. ANALYSIS OF ENUMERATOR AND CREW LEADER SURVEYS

The preceding analysis was based on our earlier study of the 1990 NRFU and used similar data—administrative data describing enumerators' demographic characteristics, hours of work on the census, and cases completed, as well as published data describing the characteristics of the areas in which the enumerators worked. In this section we combine those data with survey data that fill several important gaps in our knowledge to further analyze the factors that affect NRFU performance of individual enumerators.

This work is modeled on the analysis contained in our *Dress Rehearsal Evaluation Report* issued in February 1999, which was based on the use of pre-NRFU and post-NRFU surveys of 1,030 enumerators, roughly half of those working on the dress rehearsal in Columbia, South Carolina, and Sacramento, California. The dress rehearsal study reached the following important conclusions:

- Variation between census pay and local pay across Sacramento and each of the 11 counties in Columbia was sufficient to show that a $1 reduction in census pay would increase attrition from 17.5 percent to 21.0 percent. This result was consistent with our estimates of the effect of pay on attrition during the 1990 NRFU.

- Enumerators who commanded high pay at other jobs were less likely to quit or be fired than enumerators who had little work experience or had held low-wage jobs. However, enumerators employed full-time at other jobs worked fewer hours per week at their census jobs.

- Higher census pay attracted applicants who previously held higher paying jobs.

- The Sacramento local census office (LCO) did not hire and train the number of enumerators called for in the frontloading plan. As a result, 20 percent of enumerators working in Sacramento were trained after the NRFU got underway, compared to only 5 percent of the Columbia enumerators. The difference in frontloading raised cost by reducing productivity (cases completed per hour) due to:

  - Reducing crew leaders' ability to assign the most work to the most productive enumerators; and

  - Reducing the average experience level of enumerators working each week.

- At the same time, the Sacramento LCO used the number of hours per week an applicant was able to work as a hiring screen and asked enumerators to work 15 to 20 percent more hours per week than enumerators were asked to work in Columbia. This reduced cost and speeded completion of the NRFU, without adversely affecting

retention, but was insufficient to fully offset the effect of lower-than-planned frontloading.

- In contrast to our 1990 findings, leaving prematurely showed only a weak negative correlation with test scores. This largely was a result of higher wages dramatically reducing the fraction of enumerators hired with low test scores, and enumerators with low test scores (score below 82 or so) being much more likely to leave prematurely than other enumerators.

It is important to keep in mind that special circumstances occurred during the dress rehearsal that created the variation needed to greatly facilitate estimating key relationships, but those circumstances were not repeated during the 2000 NRFU.

First, as far as we know, there was not much variation across LCOs in the number of hours enumerators were asked to work per week. Second, there was a shortage of qualified applicants in Sacramento because 60 percent of the recruits did not live within the relatively small portion of Sacramento included in the dress rehearsal. Third, there was an unusually large amount of variation in local pay across the counties spanned by the Columbia LCO. This occurred because the Columbia dress rehearsal LCO was much larger than the Columbia Census 2000 LCO and included the three South Carolina counties bordering North Carolina, which were in easy commuting distance of the high-wage areas surrounding Charlotte.

The large reductions in variation in test scores, census pay, and other key factors across the 2000 LCOs substantially limited our ability to estimate the effect of differences in these factors on completion of the NRFU. Also, higher levels of wages and frontloading appear to have severely reduced the correlation between NRFU performance test scores, pay, and factors found to have substantial effects during the 1990 NRFU.

The analysis presented below primarily focuses on describing key attributes of the 2000 NRFU and what factors affected that performance. It is more limited than that presented in our dress rehearsal study because we have a lot less to say about the effect of Census pay on NRFU performance. A key finding is that by increasing frontloading and dramatically increasing retention through increasing wages, the Census Bureau appeared to achieve a high degree of control over completion time and cost.

7.1 Data Sources

This analysis is based, in part, on the same three types of administrative data we used to conduct the LCO-level analysis presented in preceding sections:

- Job applications describing the demographic characteristics of recruits;
- Pre-Appointment Management System/Automated Decennial Management System (PAMS/ADAMS) data describing the number of hours enumerators worked each day; and
- Operations Control System 2000 (OCS-2000) data describing the number of cases (interview forms) completed by each enumerator that was logged into the system each day.

These data differed from those used in the 1990 NRFU study in several key respects. First, cases-completed data came from a separate file, where we knew the date the cases were entered into the system, but not necessarily the date the interviews were conducted. In 1990 and the dress rehearsal, a single file included hours and cases in order to properly calculate the bonus, which was dropped for the 2000 NRFU. In addition, entering prior work history variables into the application database was no longer mandatory. Thus, we lacked highly useful administrative data on prior earnings and dates of employment.

This study, like its predecessors, used similar Bureau of Labor Statistics (BLS) *Employment and Wages* data to describe local pay, and data published by the Census Bureau from *The State and County Data Book* to describe area characteristics. The 1990 published data were superior to those available for this study because we conducted the 1990 NRFU study well after measures of local wages and 1990 county-level variables derived from the 1990 decennial census itself became available.

The analysis described below also used data we collected through five special surveys to deal with some of the data limitations noted above and collect additional data suitable to address a

number of questions that could not be examined using administrative data alone. These surveys were developed by Westat and covered about half of the crews in 27 specially selected LCOs[5]:

- A **pre-NRFU survey** of enumerators conducted by crew leaders during enumerator training that details the work history and family background of enumerators.

- An **interim survey** of enumerators conducted by crew leaders after the end of the first week of field work that describes the commute time and whether enumerators worked in their own neighborhoods or similar neighborhoods. A packet of three surveys included in a single "blue-book" packet that was filled out by crew leaders and returned to us after the crew completed 80 percent of its work.

A "blue-book" that included three separate elements:

- A **roster** maintained by crew leaders describes (1) when enumerators received their training, (2) when they stopped working for their initial crew (exit timing), and (3) why they stopped working for their initial crew (exit status).

- A **post 80 percent completion questionnaire** filled out by the crew leader after the crew completed 80 percent of its work covering each crew member that describes (1) when the crew member began work, (2) how many cases he or she completed, (3) how many hours he or she worked on weekends, evenings, and weekdays, and (4) ratings of various elements of the crew member's performance.

- A **crew leader questionnaire** that describes the characteristics of the area in which the crew worked, and the crew leader's rating of various job elements including assistance received from supervisors.

These surveys filled three important gaps in the record provided by administrative data alone. First, we wanted to know why enumerators stopped working on the NRFU. Specifically, we wanted to know if they quit, were fired, or transferred for poor performance; were not given additional assignments by the crew leader; were transferred to other work for good performance; or were given assignments until no more work was available.

Second, we wanted to know more about the enumerators' employment status and family responsibilities. Specifically, we wanted to know if they held full-time or part-time jobs while working on the NRFU, took temporary leaves from jobs, were retired, or caring for dependents.

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[5] Our initial sample included 30 LCOs that reflected the diverse area characteristics and recruiting performance of the universe of Census 2000 LCOs. To study the role of regional management we included LCOs in 11 of the 12 Census Regions. In addition, we selected LCOs in central cities, suburbs, and rural areas near each of 9 major U.S. cities. This enabled 9 of our 10 site visitors to observe operations in diverse areas. (Because the Laredo LCO covered an exceptionally large area, that one visit had to be confined to a single LCO). Finally, although we over-sampled LCOs where recruiting was especially difficult, we excluded three of those LCOs from this analysis. This brought the sample down to 27 LCOs whose average characteristics closely matched those of all 510 LCOs in our database.

Third, we wanted to know more about the area where the enumerators worked. In particular, we wanted to know if they worked in large cities, suburbs, small cities, or rural areas; the types of housing they visited; and the affluence of the area.

To conduct these surveys, 10 Westat representatives trained crew leaders to administer the surveys during site visits conducted in late April and early May of 2000 when the crew leaders were being trained. We also arranged for regional technicians to monitor the return of three separate sets of completed surveys to Westat. The samples derived from each of the three separate submissions **after** matching with administrative data are shown in Table 7-1.

Table 7-1. Samples derived from the three submissions

	Number of enumerators
1. The pre-NRFU survey	5,172
2. The interim survey	3,002
3. The "blue-book"	7,385
Number of crews	376

There were about 2,000 fewer enumerators in the pre-NRFU surveys than in the blue-books because about 40 percent of the crew members had not joined the crew at the point the crew leader administered the pre-NRFU survey. There are about 2,000 fewer interim surveys than pre-NRFU surveys because many crew members were not at work in the first week when the surveys were supposed to be completed and because some crew leaders were too busy to administer the interim surveys.

Almost all of the crew members in the 27 LCOs who completed the pre-NRFU survey were included in the blue-books because we took several steps to get as complete a response as possible. First, we asked the regional technicians to contact crew leaders who did not turn in the blue-books. Next, we mailed letters directly to the crew leaders asking them to return the blue-books. Finally, we telephoned most of the crew leaders who did not respond to either of the first two exhortations and asked them to return the blue-books.

Our usable sample was reduced because it was not always possible to match administrative data to the survey data for a given individual. We believe that this usually occurred when those surveyed failed to provide accurate Social Security account numbers. Also, our sample was slightly reduced

because those filling out the surveys did not respond to certain key questions. However, the presence of missing responses for virtually all key items was quite low, usually 6 percent or less, and therefore, did not materially affect our analysis.

In Section 7.2 we discuss results based on the large blue-book sample that included the rosters, crew member surveys, crew leader survey, and all three sources of administrative data. However, our regression results presented in the following subsection are restricted to a considerably smaller sample of individuals for whom we had data from all eight sources.

7.2 Employment Characteristics during the Non-Response Follow-Up (NRFU)

In this section we describe the key employment characteristics of the enumerators hired to conduct the Non-Response Follow-Up (NRFU) covered in the crew leader surveys conducted among 376 crews in 27 LCOs. Our primary focus is describing when enumerators began work, ended work, and the reason they stopped working; and on how these factors affected enumerators' performance as measured by the number of cases completed per enumerator and the rating they received from their crew leaders.

Table 7-2 divides the enumerators into five groups based on whether they ever worked with the crew with which they trained, whether they began work during the first week the crew was in the field, and whether they were still at work at the point the crew completed 80 percent of the cases assigned to the crew. (The 80 percent point was selected because the nature of operation changes at about this point to more of a mopping-up operation where residences are revisited and most crew members have been released.)

About 8 percent of the enumerators assigned to the crew did not work with the crew at all; 70 percent began working the first week the crew was in the field, and 22 percent began working after the first week. Information in our databases suggests that one-quarter of the crew members who started after the first week transferred from other crews. This may reflect Census Bureau redeployment of additional staff to understaffed or poorly performing LCOs. An additional one-quarter were hired and trained while the crew was in the field. The remainder were trained with the crew but were not asked to work during the first week.

Table 7-2. Start and end status of crew members by cases completed and rating

			% of enumerators (1)	% of cases (2)	Cases per enumerator (3)	Crew leader rating (4)
1.	Trained but did not work with crew		7.9	0.0	—	—
	Started 1st week	Working when NRFU 80% complete				
2.	Yes	Yes	50.9	72.5	129	4.0
3.	No	Yes	15.4	15.2	89	3.7
4.	Yes	No	18.9	9.3	45	2.7
5.	No	No	6.9	3.0	40	2.7

Of those starting the first week, 73 percent continued to work at least until the crew completed 80 percent of its workload, and an additional 10 percent left the crew but continued to work on the census. The retention rate was about as good for those who started after the first week. These are remarkably high retention rates, especially when compared to those for the 1990 census, when the permanent separation rate averaged 26 percent **each week**.

Column 2 of Table 7-2 shows that 72.5 percent of all cases were completed by enumerators starting on the first week of field operations and remaining until 80 percent of the work was completed; 15.2 percent were completed by those who started after the first week and remained until 80 percent of the work was completed; 9.3 percent were completed by those who started the first week but did not remain until 80 percent of the work was completed; and 3 percent were completed by those who started after the first week and did not remain until 80 percent of the work was completed.

One striking feature of these results is that it appears that the strategy to offer higher wages and frontload hiring provided enough enumerators to complete the NRFU with only a minor need to hire and train additional enumerators while the NRFU was being conducted. The results suggest that a core of about half of those hired and trained were able to complete the bulk of the work with little need for additional assistance.

Table 7-3 displays the primary reason enumerators in each of the groups shown in Table 7-2 left census employment. As expected, most of those who did not work with the crew in the field quit, and

a relatively small number were fired. The remainder transferred to other crews or did not have their end-status reported.

Table 7-3. Start and end status of crew members by reason for separation

			Quit (1)	Fired (2)	No work assigned (3)	Other (4)
1.	Trained but did not work with crew		64.8%	12.8%	—	22.5%
	Started 1st week	Working when NRFU 80% complete				
2.	Yes	Yes	8.5%	0.7%	12.0%	78.8%
3.	No	Yes	7.0%	1.4%	11.6%	80.0%
4.	Yes	No	57.4%	12.1%	18.6%	11.9%
5.	No	No	42.7%	13.5%	23.3%	20.5%

The quit and fire rate was about the same for enumerators who started the first week but left before the 80 percent completion point was reached, as for those who never started. However, an important reason that about one-fifth left is that they were willing to continue working, but no more work was assigned to them by their crew leaders. Given the low ratings these individuals received, it is likely that the crew leaders felt the crew would be more effective without the services of these individuals.

Among enumerators who did not reach the 80 percent completion point, the separation reasons for crew members who started after the first week differ from those who started the first week, mainly because those who started later had less time to quit and were more likely to be present when work began to run out. However, the fraction of those who were not assigned more work while work was available is about 5 percentage points higher among those starting after the first week than those starting the first week. This suggests that enumerators became more productive as they gained experience over the first few weeks. Thus, crew leaders would give more work to enumerators who had already worked several weeks.

Finally, much as expected, about 80 percent of the enumerators who reached the 80 percent completion point were assigned work to the very end of the enumeration period. Relatively few quit or were not given additional assignments, and hardly any were fired. This suggests that crew leaders and

other managers did a good job in culling out the less productive enumerators and were able to keep the core workforce fully employed as operations were completed.

Table 7-4 provides a more comprehensive look at the association between the reason for separation and the amount of work an enumerator in a given group completed. The separation statuses are ordered from lowest cases-per-enumerator to highest. Overall, only 5 percent of the enumerators in our sample were fired, but clearly that group performed poorly based on the cases they completed per person and the rating they were given by their crew leaders.

Table 7-4. Separation status of crew members by cases completed and rating

	% of enumerators	% of cases	Cases per enumerators	Crew leader rating
1. Fired	5.0%	1.6%	29	1.9
2. Quit	24.4%	10.6%	38	3.1
3. Transferred-poor performance	0.9%	0.6%	61	1.9
4. Not given assignments	13.5%	9.3%	61	2.7
5. Still working	9.7%	12.2%	111	4.1
6. Nor more work available	39.5%	55.4%	124	4.1
7. Transferred-good performance	6.5%	9.9%	134	4.4

7.3 Factors Affecting the Number of Cases Completed per Enumerator

In this section we use tabulations to examine the factors that affected the performance of individual enumerators. Understanding how various factors both within and outside of the control of census managers affect individual performance can greatly improve planning for the 2010 NRFU. In particular, knowledge of which factors make the biggest difference and which factors are of little importance can help census officials modify design features so they have the largest positive effects.

More specifically, one key goal of this analysis is to explain why there was little correlation between census pay and retention during the 2000 NRFU, but the correlation was high during the 1990 NRFU. Also, we describe how information about pay and employment that was known at the time enumerators were hired affected performance. While these variables were not used in making hiring

decisions in 2000, their use could substantially speed the completion and modestly reduce the cost of the 2010 NRFU.

This analysis describes the effect of various factors on the number of cases completed by the end of the fourth week of NRFU field operations by each person in our sample for whom we have all eight types of data, and who primarily worked as an enumerator. We limit the analysis to enumerators for whom we have the maximum amount of information to examine the effect of as many factors as possible.

We limited the analysis to the first 4 weeks of field operations because crews were putting out a maximum effort during that period. After the fourth week, getting high hourly production and high retention from each enumerator became less important. However, the rate at which operations slackened as the bulk of work was completed varied substantially across crews. Thus, by focusing on the early period we obtain the best evidence about how much work can be done by enumerators with different characteristics in different types of areas.

We limit that analysis to individuals who primarily worked as enumerators because many of the enumerators who completed the most cases during the first week or two were subsequently promoted to crew leader assistants, crew leaders, or other positions where completing cases was not their primary responsibility.[6] Inclusion of these individuals, therefore, would provide highly misleading evidence about the importance of various factors on the total number of cases completed over the first 4 weeks of field operations.

Also, enumerators were shifted to different crews from the ones they started with and some crews were shifted to areas quite different from where they began their work. There appeared to be an increase in the tendency to shift enumerators to new crews after the fourth week. Thus, limiting the analysis to the first 4 weeks makes it most likely that the crew-specific variables in our data set apply to the area in which the enumerator performed most, if not all, of his or her work.

[6] We excluded nonenumerators by requiring each person in our sample to have completed at least one case and completed at least 0.3 cases per hour worked during the period of NRFU field operations.

Characteristics Associated with Completing Different Amounts of Work

Table 7-5 describes variation in about 100 factors that could be associated with differences in the performance of the 2,751 enumerators in our sample. The enumerators are divided into four production groups based on the mean and standard deviation of cases completed by the end of the fourth week. The performance of Group 1 was above average by at least one standard deviation. Group 2's performance was above average by less than least one standard deviation. Group 3's performance was below average by less than one standard deviation. Group 4's performance was below average by at least one standard deviation.

Group 1 included 13.7 percent of enumerators. On average, each Group 1 enumerator completed 234.6 cases. Group 2 included 28 percent of enumerators, who completed 133.8 cases on average. Group 3 included 46.1 percent of enumerators completed, and completed 71.0 cases on average. Group 4 included 12.1 percent of the enumerators, and this group completed, on average, only 22.9 cases.

Clearly, there were enormous differences in the number of cases different enumerators completed. Also, while roughly one-fourth of the enumerators were equally divided between the lowest and highest group, almost half of the enumerators were in the one standard deviation below average group. That relatively few enumerators completed exceptionally small or large numbers of cases is in keeping with expectations. Also, because there is a high upper limit to the number of cases that could be completed, but a lower limit of zero, we would expect that relatively few enumerators would be above average, but those enumerators would exceed the average number of cases by large amounts. In contrast, we would expect that enumerators with below average performance would be larger in number, but complete close to the average number of cases.

In addition, the extremely wide range of cases completed by individual enumerators suggests that, if the sources of those differences could be identified and influenced, it might be possible for the Census Bureau to find ways to increase the number of cases completed by the average enumerator. Boosting the average number of cases completed could lead to large increases in speed and modest decreases in cost.

Panel A, Pay Characteristics, is the first of seven sets of factors we examine in Table 7-5. Line 4 shows that local pay was lower by more than $2.00 among enumerators in Group 1 (who completed the most cases) compared to enumerators in Group 4 (who completed the fewest cases). This

Table 7-5. Factors associated with enumerators completing different numbers of cases

		1 Group 1	2 Group 2	3 Group 3	4 Group 4	5 All	6* % difference
1	Number of enumerators	378	771	1,267	335	2,751	Group 4
2	Enumerator distribution	13.7%	28.0%	46.1%	12.2%	100.0%	
3	Number of cases completed weeks 1 through 4	234.6	133.8	71.0	22.9	105.2	164.4%
A. Pay Characteristics							
4	Local pay	$14.98	$15.97	$16.76	$17.03	$16.33	-12.8%
5	Census pay	$11.82	$12.58	$12.94	$13.01	$12.69	-9.6%
6	Census pay as a % of local pay	78.9%	78.7%	77.2%	76.4%	77.8%	3.2%
7	Enumerator's prior pay	$13.93	$12.93	$13.34	$12.73	$13.23	9.0%
8	Census pay as a % of prior pay	84.8%	97.3%	97.0%	102.2%	96.1%	-18.6%
	Prior pay distribution						
9	$0.01 to $6.99	0.209	0.210	0.194	0.203	0.202	2.9%
10	$7.00 to $9.99	0.159	0.211	0.196	0.188	0.194	-16.9%
11	$10.00 to $15.32	0.270	0.230	0.240	0.239	0.241	12.2%
12	Greater than $15.32	0.225	0.210	0.223	0.221	0.220	1.8%
13	Pay $0.00 or unknown	0.138	0.139	0.147	0.149	0.144	-8.1%
B. Prior Work History Characteristics							
	Last worked prior to enumerator training						
14	One week before	0.339	0.379	0.472	0.499	0.431	-38.2%
15	Not one week, but within 3 months	0.175	0.200	0.170	0.170	0.179	2.6%
16	Longer ago than 3 months	0.476	0.416	0.350	0.316	0.382	40.3%
17	Unknown	0.011	0.005	0.009	0.015	0.009	-34.1%
	Primary employment status last 52 weeks						
18	Working at least 35 hours per week	0.241	0.263	0.348	0.340	0.309	-34.3%
19	Working, but less than 35 hours a week	0.151	0.156	0.143	0.143	0.148	5.1%
20	Self-employed	0.090	0.078	0.063	0.051	0.069	55.7%
21	Looking for work	0.063	0.082	0.071	0.081	0.074	-23.7%
22	Laid off	0.008	0.009	0.009	0.000	0.008	200.0%
23	Retired	0.206	0.157	0.117	0.107	0.139	63.0%
24	Not working, not looking	0.032	0.032	0.027	0.018	0.028	55.7%
25	Family caregiver	0.087	0.091	0.056	0.060	0.071	37.6%
26	Student	0.040	0.047	0.077	0.096	0.066	-82.6%
27	Unknown	0.082	0.086	0.089	0.104	0.089	-24.1%

Table 7-5. Factors associated with enumerators completing different numbers of cases (continued)

		1 Group 1	2 Group 2	3 Group 3	4 Group 4	5 All	6* % difference
C. Demographics							
28	**						
29	**						
30	**						
31	**						
32	U.S. citizen	0.960	0.947	0.929	0.976	0.944	-1.6%
33	Receiving a pension	0.315	0.220	0.196	0.215	0.221	37.7%
34	Test score	90.2	90.1	89.7	89.8	89.9%	0.4%
35	Fraction with score greater than 90	0.516	0.567	0.530	0.558	0.542	-7.9%
36	Fraction with score less than 75	0.045	0.049	0.045	0.051	0.047	-12.1%
D. Additional Performance Measures							
	Enumerator performance through the fourth full week						
37	Weeks worked	4.02	3.96	3.68	2.54	3.67	45.3%
38	Hours worked per week	37.2	30.1	23.7	14.4	26.2	88.4%
39	Cases completed per hour	1.466	1.098	0.866	0.515	0.971	96.0%
40	Rating by crew leader (1-5 scale)	4.409	4.046	3.353	2.719	3.615	47.4%
	Crew performance-related measures						
41	No. of cases other crew members completed	1,266	1,057	927	935	1,011	30.1%
42	No. of crew members in sample	9.42	9.19	9.23	9.43	9.27	-0.1%
43	Percent of cases completed by end of week 4	0.865	0.851	0.827	0.792	0.835	8.8%
44	Cases completed per other crew members by end of week 4	130.0	109.9	93.2	87.8	102.3	38.7%
45	Original crew leader remained with crew	0.648	0.593	0.594	0.588	0.601	9.7%
E. Reason for Separation (exit status)							
46	Quit	0.026	0.080	0.168	0.376	0.149	-173.7%
47	Fired	0.000	0.012	0.021	0.057	0.020	-200.0%
48	Transferred for good performance	0.122	0.078	0.050	0.021	0.064	141.4%
49	Transferred for poor performance	0.003	0.005	0.006	0.009	0.005	-108.8%
50	Not given additional work	0.032	0.064	0.150	0.197	0.115	-144.5%
51	Ran out of work	0.579	0.502	0.343	0.206	0.403	95.1%
52	Still working	0.101	0.126	0.122	0.042	0.111	82.5%
53	Unknown	0.138	0.134	0.140	0.093	0.132	39.1%

Table 7-5. Factors associated with enumerators completing different numbers of cases (continued)

		1 Group 1	2 Group 2	3 Group 3	4 Group 4	5 All	6* % difference
F. Area Characteristics							
	LCO as a whole						
54	Population density	513	793	1131	1142	953	-76.0%
55	Recruiting target	4,337	4,329	4,559	4,867	4,502	-11.5%
56	Applicants in Feb. as a % of target	110.4%	113.8%	105.2%	99.2%	107.6%	10.6%
57	Most residents low income	0.384	0.394	0.390	0.352	0.386	8.5%
58	Most residents high income	0.127	0.171	0.204	0.206	0.185	-47.4%
59	Mixed moderate and high	0.148	0.119	0.107	0.104	0.116	34.6%
60	Mixed moderator and low	0.106	0.078	0.087	0.101	0.089	4.2%
61	Other	0.111	0.071	0.059	0.081	0.072	31.8%
62	Unknown	0.124	0.166	0.153	0.155	0.153	-22.1%
63	25%+ residents farms	0.122	0.109	0.110	0.134	0.114	-9.9%
64	75%+ residents single family homes	0.505	0.511	0.455	0.424	0.474	17.5%
65	50%+ residents apartments	0.069	0.082	0.110	0.119	0.097	-53.8%
66	Mixed	0.175	0.148	0.180	0.179	0.170	-2.5%
67	Unknown	0.130	0.150	0.146	0.143	0.145	-10.0%
	Area where crew member worked initially						
68	Own neighborhood	0.376	0.410	0.446	0.493	0.432	-26.9%
69	Similar neighborhood	0.386	0.361	0.329	0.310	0.344	21.8%
70	Dissimilar neighborhood	0.222	0.208	0.212	0.173	0.207	24.8%
71	Unknown	0.016	0.022	0.013	0.023	0.017	-40.5%
72	Commuting time, if own (minutes)	11.0	11.2	11.8	9.9	11.3	9.8%
73	Commuting time, if similar	16.6	16.3	16.4	16.5	16.4	0.3%
74	Commuting time, if dissimilar	20.3	19.9	20.6	19.3	20.2	5.3%
G. Enumerator distribution by LCO							
75	Stamford, CT 2116	0.011	0.013	0.046	0.033	0.030	-102.5%
76	New York City–Northeast 2235	0.003	0.009	0.017	0.027	0.014	-164.1%
77	New York City–Northwest 2236	0.000	0.010	0.011	0.021	0.011	-200.0%
78	Queens, NY 2240	0.000	0.010	0.037	0.039	0.025	-200.0%
79	Flint, MI 2416	0.034	0.042	0.049	0.045	0.044	-26.2%
80	Midland, MI 2423	0.106	0.067	0.058	0.051	0.066	70.4%
81	Saginaw, MI 2425	0.034	0.036	0.041	0.048	0.040	-32.5%
82	Clarksville, TN 2540	0.069	0.053	0.028	0.018	0.040	117.4%
83	LaCrosse, WI 2547	0.016	0.026	0.035	0.048	0.031	-100.2%

Table 7-5. Factors associated with enumerators completing different numbers of cases (continued)

		1 Group 1	2 Group 2	3 Group 3	4 Group 4	5 All	6* % difference
G. Enumerator distribution by LCO (continued)							
84	Minneapolis, MN	0.003	0.005	0.036	0.122	0.033	-191.5%
85	Rochester, MN 2629	0.061	0.044	0.050	0.084	0.054	-31.5%
86	St. Paul, MN 2631	0.000	0.003	0.009	0.006	0.006	-200.0%
87	Concord, CA 2713	0.026	0.054	0.037	0.051	0.042	-62.9%
88	Oakland, CA 2718	0.008	0.019	0.027	0.006	0.020	28.3%
89	Covington, KY 2812	0.011	0.009	0.006	0.012	0.008	-12.1%
90	Charlotte, NC 2818	0.005	0.012	0.022	0.009	0.015	-51.4%
91	Rock Hill, NC 2833	0.026	0.029	0.020	0.024	0.024	10.2%
92	Birmingham, AL 2911	0.037	0.039	0.039	0.015	0.036	85.1%
93	Gadsden, AL 2912	0.124	0.034	0.017	0.021	0.037	142.5%
94	Newnan, GA 2951	0.016	0.045	0.025	0.018	0.029	-12.1%
95	Laredo, TX 3043	0.021	0.058	0.051	0.042	0.048	-65.5%
96	Phoenix, AZ–North 3112	0.124	0.084	0.071	0.048	0.079	89.0%
97	Phoenix, AZ–South 3114	0.037	0.054	0.054	0.066	0.053	-55.8%
98	Scottsdale, AZ 3115	0.114	0.083	0.058	0.060	0.073	62.3%
99	Los Angeles, CA 3226	0.011	0.023	0.062	0.033	0.041	-102.5%
100	Woodland Hills, CA 3245	0.074	0.056	0.024	0.033	0.041	77.1%
101	Pasadena, CA 3252	0.029	0.080	0.069	0.024	0.061	19.7%

Notes:

* Column 6, Percent Difference, is calculated as the ratio of twice the difference between columns 1 and 4, divided by the sum of columns 1 and 4. This figure is a representation of the magnitude of the difference between columns 1 and 4.

**Gender and age ranges were used as control variables in order to improve the fit of the overall model (items 28-31).

Shaded numbers in column 1 are substantially greater than the unshaded number in column 4 on the same line (and usually greater than the numbers in columns 2 and 3).

Shaded numbers in columns 2 and 3 are the highest number on their line.

Shaded numbers in column 4 are substantially greater than the unshaded number in column 1 on the same line (and usually greater than the numbers in columns 2 and 3).

finding is similar to our earlier result that LCOs with high local pay completed the NRFU more slowly than LCOs with relatively low local pay. Thus, it reinforces the view that completing the NRFU was more difficult in high-wage areas.

Also, as was the case with our cross-LCO analysis, census pay was higher where local pay was higher, but the ratio of census pay to local pay fell as levels of local pay increased. Thus, at first glance it appears possible that differences in cases completed across enumerators are causally related to the differences in the census-to-local pay ratio.

It also is worth noting that the average pay ratios on line 6 are below .81, the average ratio across all LCOs. Most of this difference stems from each LCO being given equal weight in estimating the pay ratio in an average LCO, but this sample is weighted by the number of enumerators—and there were many more enumerators in LCOs where local pay was high—and the census-to-local pay ratio low.

Line 7 of Table 7-5 shows the average prior pay level of enumerators in each group (who told us their prior earnings). These results show that Group 1 enumerators had higher prior pay than other enumerators, even though they were working in areas where local pay and census pay were well below average. Precisely the reverse is true for enumerators in Group 4 who had lower pay, even though they worked in higher wage areas. Pay in the middle two groups was between that in Groups 1 and 4, and about equal to each other. This result suggests that, at least up to a point, enumerators who commanded higher pay prior to working for the Census Bureau were more productive as enumerators. At the same time, line 8 shows that census pay was low relative to enumerators' prior pay for the most productive enumerators, but was high relative to enumerators' prior pay for the least productive enumerators.

Both of the above findings have important implications for assessing the effect of pay on performance. Our analysis of the 1990 NRFU suggested that where census pay was especially low relative to local pay, it was difficult to attract and retain high wage workers (or other workers likely to be highly competent). However, we expected that the ratio of a worker's own pay to pay at a possible job opening would be a better measure of the attractiveness of a given job than the ratio of average pay in a given area to pay at a prospective job. Thus, we would expect higher turnover among relatively high wage enumerators.

That high prior wage enumerators completed more cases relative to other categories in 2000 suggests that retention was not adversely affected by wages being low relative to what workers were

earning at other jobs. We suspect that in 2000, census wages were above the threshold level needed to retain high wage workers. As a result, the positive association between pay ratios being high and attrition being low that we observed in 1990 was not observed in 2000. Instead, we believe that higher wages had positive effects on 2000 performance by improving the quality of the applicant pool.

In other words, when census wages are very low relative to an area's average, workers attracted to census jobs are less capable of executing the work, and they are less likely to continue working on the NRFU despite their desire to boost their earnings. But when census wages are above a threshold level, high wage workers are attracted to the census jobs. These workers are competent to execute the work and are committed to working until released.

In short, these results suggest that even though 2000 census wages were lower than average local prevailing wages, they were still high enough to recruit sufficient numbers of competent workers.

Lines 9 through 13 of Table 7-5 shed additional light on differences in the prior pay of enumerators in the four groups. The main reason that pay is higher among Group 1 enumerators than Group 4 enumerators is that more Group 1 enumerators earned between $10.00 and $15.32 per hour, and fewer earned between $7.00 and $9.99 per hour. That the highly productive workers in Group 1 were mostly earning only a little more than census was paying reinforces the view expressed above that census pay was high enough to dramatically improve the quality of the recruit pool.

Panel B, Prior Work History Characteristics, provides additional information that further explains why high prior wages were associated with high performance—the high wage workers attracted to enumerator jobs were unlikely to be employed at the point they began enumerator training. Line 14 shows that almost one-half of the enumerators in Group 4 (and Group 3) were employed at the point they started enumerator training, compared to just over one-third of the enumerators in Group 1 (and Group 2). Although not shown in the table, roughly the same proportions were working at other jobs while working on the NRFU. Line 16 shows that the ratios were reversed among enumerators who had not worked for more than 3 months.

Lines 18 through 27 show how employment status relates to NRFU performance. Line 18 shows that not only were Group 4 enumerators likely to be employed, but they also were much more likely to have held full-time jobs, while Group 1 enumerators were much more likely to be retired or

otherwise largely out of the labor force. Indeed, about twice the proportion of retirees were in Group 1 than Group 4, and half the proportion of retirees were in Group 3 than in Group 2.

Because enumerators in Groups 1 and 2 committed much less time to noncensus work and/or had more flexibility to arrange their hours of census work than enumerators in Groups 3 and 4, it is reasonable to believe that high wages (relative to local wages) at their current or most recent non-census job reflect an enumerator's quality far more than they reflect the high value of the enumerators' time spent working on the NRFU.

However, there is one major exception to the pattern of high cases completed being associated with working less and/or having more flexibility to arrange work time—twice the proportion of students were in Group 4 than Group 1. However, the relatively poor performance of students appears to be strongly shared across all young enumerators and is not especially associated with being in school.

Panel C, Demographics, primarily shows that there was almost no variation across the four performance groups in average test scores. Thus, in contrast to our results for the 1990 NRFU, high test scores were not associated with superior performance. However, test scores were remarkably high in 2000, just below 90, with only 4.7 percent having scores below 75. During the 1990 NRFU, about five times more enumerators had test scores below 75. Our recently completed recruiting report showed that the dearth of enumerators with low scores in 2000 was directly related to the large wage increases over 1990; and in contrast to the effect on retention, higher wages in 2000 made recruiting easier and raised the quality of applicants (as measured by their test scores and prior wages).[7]

Panel D, Additional Performance Measures, describes the three key factors that determine the number of cases enumerators completed in weeks 1 through 4:

- Weeks worked;
- Hours worked per week; and
- Cases completed per hour.

[7] Information about demographic characteristics that could not be used to select enumerators was omitted from lines 28 through 31 of Table 7-4, but these variables were included in the regressions presented later in this paper so as not to bias coefficients describing the effect of other variables included in the regressions.

Of these three factors, weeks worked had the smallest effect because, except for Group 4 enumerators, relatively few enumerators permanently left enumerator jobs before the end of week 4. Indeed, Group 1 enumerators worked slightly more than 4 weeks on average because a few started in the week before the first full week.

Differences in hours worked per week and cases completed per hour, however, each accounted for roughly 40 percent of the difference in cases completed across the four groups. The differences were especially large between Groups 1 and 4.

It is easy to understand how there could be large differences in the number of hours worked by enumerators in each of the four groups and how those large differences could account for large differences in the total number of cases completed. But it is harder to explain why differences in hourly productivity (cases per hour) would be so large. It appears that a combination of factors including differences in motivation, ability, and inherent ease of completing cases accounts for the roughly 30 percent increase in hourly productivity between Group 3 enumerators and Group 2 enumerators, as well as between Group 2 enumerators and Group 1 enumerators.

These same factors also appear to account for much of the difference in hourly productivity between Group 4 and Group 3 enumerators. In addition, the exceptionally low hourly productivity of Group 4 enumerators is partially due to there being a certain amount of fixed setup time for enumerators to perform their tasks in terms of getting to the work site, obtaining materials and instructions from supervisors, and arranging to have completed interview forms collected each day. For Group 4 enumerators, the setup time is a large fraction of the total time they worked. Also, it is plausible that Group 4 enumerators performed so little work that they did not fully learn their jobs.

Naturally, it would be highly desirable to determine more precisely what factors are responsible for differences in total cases completed and each of the three components. We will address this issue both in discussing the remaining variables in Table 7-5 and subsequent regression analysis.

Lines 41 through 44 provide important perspectives to what were the sources in variation across individual enumerators. In particular, line 44 shows the cases completed by other members of each enumerator's crew by the end of the fourth week. Here we see that there are large differences between individual enumerator performance and the average performance of the other crew members (in our sample).

On average, the rest of the crew to which Group 3 enumerators belonged completed only 6 percent more cases than the rest of the crew to which Group 4 enumerators belonged. However, the rest of the crews associated with Group 2 enumerators completed 18 percent more cases than the Group 3 rest-of-crew, and Group 1 rest-of-crew completed 18 percent more cases than Group 2 rest-of-crew.

These results suggest that factors associated with differences in the areas where enumerators worked or local census management practices have little effect on enumerators with well below average performance in Group 4, but could play an important role in explaining differences in performance between enumerators with above average performance in Group 1 versus Group 2, and between Group 2 enumerators and Group 3 enumerators.

Line 42 suggests that differences in crew size cannot explain cross-group differences in the number of cases completed, but line 41 suggests that it is possible that differences in cases completed could be explained by differences in the amount of work assigned to a specific crew (mainly as a result of differences in the total number of crews at work). The amount of work assigned could have a strong effect because when a crew knows it has a lot more to do, the individual members work harder. Alternatively, crews complete the easy cases first and leave the harder cases for later. Thus, when there are more cases to complete in total, there also are more easy cases to complete.

Line 43 shows that the percent of all cases completed by the remainder of the crew by the end of week 4 was positively associated with the number of cases a given crew member completes. This is an important result because it suggests that **the amount of work one crew member completes was not severely constrained by the amount of work other crew members completed up through week 4.** If this were not the case, it would have been appropriate to look at performance only through week 3.

Finally, line 45 shows that the high performance of Group 1 enumerators may have been affected by having one crew leader for the entire NRFU period. However, crew leader stability had no obvious effect on other groups.

Panel E, Reason for Separation, shows that separations due to quits, fires, and not being given additional work (when work is available) are all strongly associated with poorer performance. For example, only 2.6 percent of Group 1 enumerators quit, compared to 8 percent, 16.8 percent, and 37.6 percent, of enumerators in Groups 2, 3, and 4, respectively. Also, only 3.2 percent of Group 1

enumerators were not given additional work, compared to 6.4 percent, 15.0 percent, and 19.7 percent of enumerators in Groups 2, 3, and 4, respectively.

Because quitting is largely a decision made by the enumerator (possibly under a supervisor's duress or with the supervisor's agreement) and not being assigned work (primarily a decision made by supervisors), it appears that much of the individual variation in performance is a result of factors particular to the individual worker. However, the difference in performance across enumerators is so large that this still leaves plenty of room for area factors to have a substantial impact.

In addition, knowing that there are likely to be large variations in individual performance should affect the Census Bureau's staffing strategy. For example, knowing that about 10 percent of all enumerators who get into the field are unlikely to close many cases should influence frontloading decisions and possibly put a premium on rapidly allocating work to the enumerators who are working more than just a minimum number of hours. More specifically, our database clearly shows that most enumerators who quit never worked many hours in any week. Thus, it might make sense to inform enumerators that they must work a minimum number of hours or will be terminated.

Panel F, Area Characteristics, shows that there are several systematic differences in the characteristics of the area where enumerators worked that appear to be highly correlated with differences in individual enumerator performance. In particular, line 54 shows that the population density was more than twice as great in the areas where enumerators' performance was below average than in the areas where Group 1 enumerators worked. Similarly, density was considerably higher where Groups 3 and 4 enumerators worked than where Group 2 enumerators worked, even though the density was lower still where Group 1 enumerators worked.

These results suggest that enumerators completed more cases in rural areas than in low-density suburbs and towns, and more in suburbs and towns than in inner cities. This view is reinforced by the evidence that enumerators completed more cases when there was a lower proportion of residents living in apartment buildings and a higher proportion living in single family homes.

More generally, Table 7-5 suggests that completing many cases was considerably more difficult in high income areas than in other areas but was less difficult in places with a mix of high and moderate income areas.

Line 55 shows that completing many cases was negatively correlated with the size of the recruiting target and positively associated with the percent of the recruiting target met by the end of February 2000. These results are similar to those produced by our cross-LCO analysis and suggest that operations went more smoothly where there were fewer enumerators to supervise and where management was able to meet pre-NRFU performance goals.

Finally, lines 68 through 74 describe the association between performance and whether enumerators were working in their own neighborhoods (as judged by the enumerator), as well as the association between performance and commuting time. The most striking result is that there was a strong positive association between completing few cases and working in one's own neighborhood, but an equally strong positive association between completing many cases and working in a neighborhood similar to his or her own neighborhood.

Because the survey responses usually were obtained in the first few weeks of field operations, these results should reflect the initial assignment. If this is the case, it suggests that there is no particular advantage to hiring individuals to canvass their own neighborhood. These conclusions should be treated with caution, however, because it is possible that the surveys were administered later than planned, at which point many highly productive enumerators completed work in their own neighborhood and were working elsewhere.

Also, there were almost no differences in commuting time (once we controlled for the neighborhood similarity) across LCOs in the different performance groups; even though, as expected, commuting time increased with neighborhoods being not the same, and being dissimilar. This result also suggests that having enumerators work relatively far from their homes did not adversely affect performance at the LCO-level. However, it does not rule out longer commutes being associated with individual enumerators completing fewer cases or more productive enumerators being assigned to areas further from their homes.

Panel G, Enumerator Distribution by LCO, shows that there was substantial variation in the distribution of enumerators in each performance group across the LCOs. Many of these differences appear to be strongly correlated with the area characteristics discussed above.

For example, there were especially large proportions of enumerators with below average performance in all four LCOs in the New York metropolitan area; LaCrosse, Wisconsin; Minneapolis,

Minnesota; Concord, California (near San Francisco); Oakland, California; Charlotte, North Carolina; and Downtown Los Angeles. With the exception of LaCrosse, Wisconsin, all these areas were either affluent suburbs (Stamford and Concord) or contained high density inner city areas.

LCOs with high proportions of above average performing enumerators were Midland Michigan; Clarksville, Tennessee; Birmingham and Gadsden Alabama; Phoenix-North and Scottsdale, Arizona; and Woodland Hills, California. These areas were either smaller cities surrounded by rural areas, or mainly moderate to high-income suburbs (of Phoenix and Los Angeles).

While these results are suggestive of which underlying factors strongly affect performance, it is difficult to make this judgment based on the analysis of Table 7-5 alone. A far better means to assess the key sources of variation in performance is to use multiple regression analysis, which is the topic of the next section.

7.4 Regression Analysis of Factors Affecting Cases Completed by Each Enumerator

In this section we complement the tabular analysis in Section 7.3 by using regression analysis to directly estimate the effect of the factors discussed in the preceding section on cases completed by the 2,751 enumerators in our sample. In Section 7.5, we expand our regression analysis to look at the effect of the same factors on hours worked and cases completed per hour, as well as on total cases. At the outset, we note that an exceptionally large number of different specifications were tested in the process of determining the specification that provides the best information. Also, written comments and discussion with the four expert panel members were of great help in developing an appropriate specification.

Table 7-6 displays the full regression using as the dependent variable cases completed by each enumerator by the end of the fourth full week of the NRFU. The specification shown in Table 7-6 represents a considerable improvement upon earlier specifications because it more successfully tests the importance of threshold effects; that is, whether increases in hourly pay-rates or test-scores above a "threshold" level have little effect on enumerator performance. Thus, the specification provides a solid basis for understanding the relative importance of the factors examined in the preceding section.

Table 7-6. Regression describing the effect of various factors cases completed per enumerator

		1	2	3	4	5	6
				Mean Values for			
	Adjusted R-Square = 0.1683	Parameter estimate	Significance (Probability not = 0)	Group 4 cases 1+ std-dev below avg	Group 1 cases 1+ std-dev above avg	% difference Group 1 -Group 4	Effect of difference on cases completed (dif x coef)
	Dependent variable: Cases completed by end of week 4 Mean = 105.2 N = 2,751			22.9	234.6		38.6
	Intercept	-33.36	0.381				
A. Pay Characteristics							
1	Local pay	-1.04	0.040	17.03	14.98	-6.4%	2.12
2	Census pay	-0.39	0.763	13.01	11.82	-4.8%	0.47
	Prior pay by range						
3	$0.01 to $6.99	1.35	0.061	1.00	1.03	1.8%	0.05
4	$7.00 to $9.99	0.42	0.373	1.56	1.32	-8.3%	-0.10
5	$10.00 to $15.32	0.27	0.350	2.94	3.30	5.8%	0.10
6	Greater than $15.32	0.06	0.584	5.34	6.36	8.7%	0.06
	Pay $0.00 or unknown omitted						
							2.80
B. Prior Work History Characteristics							
	Primary employment status last 52 weeks						
7	Working at least 35 hours per week	4.51	0.361	0.34	0.24	-17.1%	-0.45
8	Working, but less than 35 hours a week	10.03	0.061	0.14	0.15	2.6%	0.08
9	Self-employed	15.27	0.015	0.05	0.09	27.9%	0.60
10	Looking for work	5.65	0.354	0.08	0.06	-11.9%	-0.10
11	Laid off	2.94	0.838	0.00	0.01	100.0%	0.02
12	Retired	7.50	0.193	0.11	0.21	31.5%	0.74
13	Not working, not looking	21.81	0.009	0.02	0.03	27.9%	0.30
14	Family caregiver	21.70	0.001	0.06	0.09	18.8%	0.60
15	Student	4.74	0.479	0.10	0.04	-41.3%	-0.26
	(Unknown omitted)						1.53
	Last worked prior to enumerator training						
16	One week before	-18.81	0.168	0.50	0.34	-19.1%	3.01
17	Not 1 week, but within 3 months	-13.70	0.318	0.17	0.17	1.3%	-0.06
18	Longer ago than 3 months	-6.37	0.637	0.32	0.48	20.2%	-1.02
	(Unknown omitted)						

Table 7-6. Regression describing the effect of various factors cases completed per enumerator (continued)

		1	2	3	4	5	6
				Mean Values for			
	Adjusted R-Square = 0.1683	Parameter estimate	Significance (Probability not = 0)	Group 4 cases 1+ std-dev below avg	Group 1 cases 1+ std-dev above avg	% difference Group 1 -Group 4	Effect of difference on cases completed (dif x coef)
C. Demographics							
19	Test score	1.46	<.0001	89.79	90.16	0.2%	0.54
20	Score greater than 90%	-14.84	0.001	0.56	0.52	-3.9%	0.63
21	Score less than 75 %	16.91	0.020	0.05	0.04	-6.0%	-0.10
22	*						
23	*						
24	*						
25	*						
26	U.S. citizen	-6.16	0.267	0.98	0.96	-0.8%	0.10
27	Receiving a pension	-8.95	0.054	0.21	0.31	18.9%	-0.89
							5.29
D. Area Characteristics							
	Areas where crew worked the most						
28	25%+ residents farms	-6.37	0.424	0.13	0.12	-4.9%	0.08
29	75%+ residents single family homes	0.48	0.946	0.42	0.51	8.8%	0.04
30	50%+ residents apartments	-0.94	0.907	0.12	0.07	-26.9%	0.05
31	Mixed	-3.41	0.654	0.18	0.17	-1.3%	0.02
	(Unknown omitted)						0.19
32	Most residents low income	1.63	0.816	0.35	0.38	4.3%	0.05
33	Most residents high income	-4.48	0.539	0.21	0.13	-23.7%	0.35
34	Mixed moderate and high	3.89	0.610	0.10	0.15	17.3%	0.17
35	Mixed moderate and low	2.63	0.740	0.10	0.11	2.1%	0.01
36	Other	3.05	0.709	0.08	0.11	15.9%	0.09
	(Unknown omitted)						0.68
	Area where crew member worked initially						
37	Similar neighborhood	-0.35	0.945	0.31	0.39	10.9%	-0.03
38	Dissimilar neighborhood	3.18	0.614	0.17	0.22	12.4%	0.16
	(Own neighborhood + unknown omitted)						
39	Commuting time, if own (minutes)	0.03	0.887	4.90	4.12	-8.6%	-0.03
40	Commuting time, if similar	-0.05	0.828	5.13	6.40	11.0%	-0.06
41	Commuting time, if dissimilar	-0.13	0.574	3.33	4.51	15.0%	-0.16
							-0.11

Table 7-6. Regression describing the effect of various factors cases completed per enumerator (continued)

	Adjusted R-Square = 0.1683	1 Parameter estimate	2 Significance (Probability not = 0)	3 Mean Values for Group 4 cases 1+ std-dev below avg	4 Mean Values for Group 1 cases 1+ std-dev above avg	5 % difference Group 1 -Group 4	6 Effect of difference on cases completed (dif x coef)
D. Area Characteristics (continued)							
	LCO as a whole						
42	Population density	-0.00	0.967	1142	513	-38.0%	0.04
43	Recruiting target	-0.00	0.073	4867	4337	-5.8%	1.61
44	Applicants in Feb. as a % of target	-6.30	0.066	0.99	1.10	5.3%	-0.70
							0.94
E. Crew performance-related measures							
45	# of cases other crew members completed by end of week 4	0.05	<.0001	935	1,266	15.0%	17.60
46	# of crew members in sample	-7.11	<.0001	9.43	9.42	-0.0%	0.05
47	% cases completed by end of week 4	91.55	<.0001	0.79	0.86	4.4%	6.68
48	Original crew leader remained with crew	1.47	0.603	0.59	0.65	4.9%	0.09
							24.41

Notes: The dependent variable, cases-completed, includes incidences where nonresponses were resolved by enumerator completing interviews, as well as by determining housing-units were vacant or no housing-unit existed at designated addresses. Demographic variables were used as control variables in order to improve the fit of the overall model (items 22-25).

Shading in column 2 indicates that coefficients are significant at least or very close to the 5 percent level.

Shading in column 6 indicates the effect of the coefficient times the difference in means is at least one-half case.

Group sums in column 6 are boxed and placed below double lines.

Column 1 of Table 7-6 presents the coefficients (parameter estimates) of a regression using as the dependent variable cases completed by the end of week 4. Column 2 displays the statistical significance of the coefficients in terms of the probability the coefficient is different from zero. Probabilities of .05 (5 percent) or less are considered to be statistically significant by convention standards.

Columns 3 through 6 provide information about how much of the difference in cases completed is explained for each variable between enumerators in Group 1 (whose performance was greater than one standard deviation above average) and enumerators in Group 4 (whose performance was greater than one standard deviation below average). In order for a given variable to explain a substantial amount of the difference, it is necessary both for the coefficient to be large (relative to the mean of the variable) and for the difference in the mean of the variable between Group 1 and Group 4 enumerators also to be large.

Panel A shows the effect of pay on cases completed. Line 1 shows that the higher the local pay, the fewer cases are completed. The parameter is statistically significant at the 0.04 level. The difference in pay between Group 1 and Group 4 enumerators was $2.05 (based on subtracting $17.03 in column 3 from $14.98 in column 4). As shown in column 6, multiplying the $2.05 difference times the local pay coefficient of -1.04 produces the estimate that, other factors equal, the local pay differences results in 2.12 more cases being completed among Group 1 enumerators than among Group 4 enumerators. Since the mean number of cases completed was 105.2, this makes a 2.12 percent difference.

Line 2 shows that holding constant local pay, where census pay was higher, *fewer* cases were completed. In contrast, our 1990 NRFU analysis showed that higher census pay (relative to local pay) was associated with *higher* production. The results on lines 1 and 2 suggest that Group 1 enumerators completed 2.59 fewer cases than Group 4 enumerators because of the difference in local and census pay.

Lines 3 through 6 show the effect of the pay enumerators received prior to working on Census 2000, holding local pay and census pay constant. Again, based on 1990 results, we would expect enumerators with high pay relative to census pay would complete fewer cases because they would be more likely to work fewer hours and fewer weeks. In 2000, however, we believe that prior pay is more of an indicator of the effectiveness of a given worker, than an indicator of how likely the worker will reduce hours or weeks of NRFU work.

The coefficients on lines 3 through 6 show how cases completed change for enumerators with successively higher prior pay levels producing what is called piecewise linear estimates. For workers with prior pay below $7.00, 1.35 more cases are completed for each $1.00 increase in pay.

While the effect of a $1.00 increase on cases completed certainly is small relative to the mean number of cases, it is quite large relative to the amount of variation we can explain with the factors included in the regression, and the result is close to significant at the 5 percent level. Thus, we believe that it provides reasonably strong evidence that enumerators who previously held low paying jobs were not as effective as other enumerators.

The effect of high prior pay on productivity rapidly diminishes as the prior pay of enumerators increases and is not close to being significant at the 5 percent level. One interpretation of this result is that above a threshold in the neighborhood of $7.00, increases in pay no longer are associated with increases in effectiveness. Alternatively, it is possible that the increases in effectiveness are balanced by decreases in incentives to work long hours. In either case, however, it appears that above $7.00 or so difference in prior earnings has no effect on cases completed.

Panel B shows the effect of prior employment status on cases completed. Here we see that three statuses have especially large and statistically significant (at the 5 percent level) effects:

- Not working, not looking;
- Family caregiver; or
- Self-employed.

Being in the first two categories increases the number of cases relative to those whose status was not determined by almost 22 cases, while being self-employed is associated with an increase of more than 15 cases.

We also see that there is a 5-case progression from typically working at least 35 hours per week, to working fewer than 35 hours a week, to being self employed, to not working or looking for work. This is evidence that having a more flexible schedule is associated with completing substantially more cases.

In addition, lines 16, 17, and 18 show that enumerators who were working at other jobs just prior to starting NRFU training completed 12.5 fewer cases than enumerators who had not worked for more than 3 months, and 5.2 fewer cases than enumerators who had not worked in the prior week. While these estimates are not statistically significant at the 5 percent level when employment status is held constant, the differences area larger and statistically significant if employment status variables are omitted.

Overall, the work history variables are associated with an increase of 3.43 cases completed by enumerators in Group 1 relative to those in Group 4. This effect is considerably greater than the pay effect but only modest compared to the size of the work history coefficients. The work history effects on cases are small because the large coefficients are multiplied by relatively small fractions. Importantly, these fractions are relatively small, even when the differences in the proportion of enumerators in a given work history group is large.

Thus, the primary importance of the effects described in panel B may not be in explaining differences across groups of enumerators, but in providing added insight into why prior pay appears to measure enumerator quality in 2000, rather than incentives to work long hours and remain at census jobs until released.

Panel C displays the effects of demographic characteristics. Lines 19 through 21 show that all three test score variables have large coefficients and are highly significant. However, when entered separately, none of these variables are statistically significant. Thus, it is the use of the variables together that make each statistically significant. A graph of the effect of the test scores on cases completed using the coefficients in Table 7-6 exhibits a sawtooth pattern. There are relatively large increases in cases completed between the breakpoints, but a major ratcheting down at each breakpoint. As a result, cases completed are about equal for enumerators with tests scores at or slightly below 74, 85, and 95.

Our interpretation of these results is that enumerator performance dramatically improves as scores rise from low levels to about 75, but within the range of scores most 2000 enumerators achieved, there is not much improvement in performance as test scores increase, and performance may fall as test scores increase above 90.[8] Thus, these results support the hypothesis that increasing wages well above

[8] The regression specification used subsequently in table 7-26 reinforces these points by making the relationship between test scores and cases completed even clearer.

1990 levels had a large effect on enumerator quality by coming close to eliminating the need to hire enumerators with scores below 75.

Even though there are only slight improvements in performance as scores rise, and very few enumerators had low scores, Group 1 enumerators gained about one case relative to Group 4 enumerators because they had slightly above average test scores, but few enumerators with scores above 90.

As was the case with pay and work history variables, the greatest value of our test score information could be to improve hiring screens. Our evidence strongly suggests that use of minimum test scores provides an excellent means to avoid hiring workers unable to adequately perform as enumerators, but using scores to select applicants who exceed a minimum level does not increase cases completed per enumerator, which is the primary determinant of completion speed.

Panel D shows the effect of three types of area characteristics on cases completed. The first type is characteristics of the relatively small area in an LCO where individual enumerators worked. The second type is whether the area is the enumerator's own neighborhood, similar to his or her neighborhood, or unlike his or her neighborhood. The third type refers to characteristics of the LCO as a whole.

We tested the effect of a large number of characteristics of the area where the crew worked. However, only three factors had large effects that were statistically significant even at the 10 percent level, but only when area variables were entered alone.

Although not shown in this paper, when only area characteristics were included in a regression, we found that in areas where most residents lived in (a) apartments, enumerators completed 15 fewer cases on average; (b) in moderate- to high-income areas, enumerators completed 15 more cases on average; and (c) in mixed-income areas, enumerators completed 14 more cases on average.

Somewhat to our surprise, we could find no evidence (from any regression specification) that enumerators working in low-income areas completed fewer cases. Rather, our results suggest that, if anything, working in affluent areas, particularly those with high-rise apartments, made completing cases difficult. Also, we have some indications that completing cases was more time consuming in predominately farming areas.

Of the nine variables included on lines 27 through 35, residents on farms and residents in high-income areas have by far the largest coefficients; but these nine variables together are associated with an increase of only.86 cases by Group 1 enumerators relative to Group 4 enumerators. Nevertheless, the information about differences in performance across areas might be of use in deciding the appropriate degree of frontloading in different areas.

Similarly, the information on lines 37 through 41 suggest that neither working in one's own neighborhood or time spent commuting has much of an effect on cases completed. In combination, the five variables in this group are associated with a reduction of 11 cases by Group 1 enumerators relative to Group 4 enumerators. However, the effect of working in one's own neighborhood could be understated because we are not certain that the survey responses reflect the area of initial assignment. Thus, high performing enumerators may have started in their own neighborhood and been highly productive there, but later transferred to other areas.

In contrast to the above results, which are not close to being statistically significant and have little ability to explain differences in performance of Group 1 enumerators versus Group 4 enumerators, higher recruiting targets (on line 43) are strongly associated with completing fewer cases. While targets were increased in areas previously identified as "hard-to-enumerate," these increases account for very little of the difference in the cross-LCO variation in the targets. Thus, this result reinforces the conclusion of our cross-LCO analysis that areas where large staffs are required perform less well.

We believe that staff size effects stem from it being more difficult for LCO managers to perform well when they have to supervise much larger numbers of enumerators and other personnel. Indeed, because our regressions take into account so many other factors that could strongly influence cases completed, it is likely that the underlying area-specific factors that make them "hard to enumerate" are being held constant.

The specification in Table 7-6 suggests that population density (line 42) has no effect on performance. However, when the three LCO-specific variables are entered in a regression by themselves, population density has an extremely large negative effect. Thus, the other variables in our specification explain why density is strongly related to cases completed.

There is also a very large difference in the coefficient on applicants in the recruiting pool when entered alone, versus in the specification shown in Table 7-6. When entered alone, the coefficient is 3.60 compared to -6.30 on line 44 of Table 7-6.

The variables that radically alter the density and recruiting pool coefficients are in **Panel E, which describes the effect on one crew member of the performance of other members in the same crew.** The effect of the variables in this group is significant; therefore, it is very important to understand why they are so potent. However, interpreting their meaning is difficult because the variables do not perfectly measure key underlying characteristics.

In particular, one variable we would like to use is the number of cases initially expected to be completed by each enumerator's crew. Because we did not have the precise variable we wanted to use, we used the total number of cases other crew members completed and the total number of other crew members as a proxy for the initial number of cases expected to be completed. The problem with this variable is that because a crew's assignment can be altered in light of how its performance compares to that of other crews, crews that are more effective on average will be given additional cases. Thus, the variable captures the ex-ante size of the assignment as well as at least some of the ex-post effectiveness of the crew.

Here is the complicated element of our analysis: Since we look only at the amount of work *other* crew members complete, their influence on the omitted member cuts in two directions. If the other crew members are highly efficient, they will reduce the amount of work the remaining enumerator will complete, but by being highly efficient, they also are likely to expand the total amount of work they will be assigned (at least over the first 4 weeks). Thus, it is likely that the two effects will approximately balance out, and we will have a good measure of the work assigned.

Thus, we regard the large positive coefficient on cases completed by other crew members (on line 45) as primarily reflecting differences in the number of cases a given enumerator could complete. As expected, the larger the assignment the more work is completed.

The negative coefficient on the number of other crew members (on line 46), which is highly significant, is also expected and fully consistent with the view that cases completed by other crew members reflect the potential amount of work to be performed. We take this view, in part, because if the

amount of work a crew could be assigned could expand without limit, adding additional crew members would increase total cases completed and not have a negative impact.

Finally, we note that the coefficient on the percent of cases completed by other crew members by the end of the fourth week (on line 47) is large, positive, and highly significant. We regard this result as evidence that the enumerators were not constrained by "running-out" of cases to complete by the end of the fourth week. Indeed, our original expectation was that this coefficient would be negative because enumerators would work less hard and/or be released as the number of cases to be completed contracted. As noted in Section 7.4, that this is not the case suggests that such constraints were not important until later in the enumeration.

Thus, we reach what we regard as one of our most important conclusions. Our evidence suggests that how quickly the NRFU was completed in a given LCO was largely a function of the number of crews and number of members of each crew.

Variation in other factors had some effect, but not nearly as great as the basic numbers of enumerators at work at any given time. This is clearly the case in explaining the difference in performance between Group 1 and Group 4 enumerators. The number of cases other enumerators completed by the end of the fourth week was associated with an increase of 24.4 cases among Group 1 enumerators relative to Group 4 enumerators. This increase accounts for just over 63 percent of all the difference that we can explain between Group 1 and Group 4 enumerators.

7.5 Factors Affecting Hours Worked and Cases Completed per Hour

In this section we combine analysis of how the variables in our database affect cases completed (cases) with analysis of how they affect the two constituent parts of cases—total hours enumerators worked (hours), and cases completed per hour (cases per hour or cph)—from the start of NRFU field operations to the end of the fourth full week of those operations.

To begin the analysis, we display in Table 7-7 the explanatory power on cases, hours, and cases per hour of the following 3 groups and 10 subgroups of variables.

- Group P–Personal Characteristics of the Enumerators
  - P1. Test scores
  - P2. Employment status at the point NRFU training began
  - P3. Pay at prior jobs
  - P4. Demographics
- Group C–Crew Characteristics
  - C1. The area in which the crew worked
  - C2. The commute to that area
  - C3. The performance of crewmembers, other than the enumerator whose performance is being analyzed
- Group L–LCO Characteristics
  - L1. Exogenous area characteristics
  - L2. Characteristics of the LCO over which the Census Bureau had some control
  - L3. Dummy variables for the LCOs

We measure explanatory power in two ways. In Table 7-7 we display the "adjusted R-square" when the variables composing each subgroup are included in regressions with cases, hours, and cases per hour (cph) as the dependent variable. (The precise variables included in each subgroup are described and analyzed in a separate subsection.) In Table 7-8 we display, for each of the 10 subgroups, the adjusted R-square when that one group is removed from the regression and the remaining 9 groups are included.

The "adjusted R-square" tells us what percentage of the variation in each of the dependent variables is "explained" by the variables. For example, the R-square is .1329 for subgroup C3–crew performance when used to explain variation in cases across the 2,751 enumerators in our sample. This is the highest explanatory power of any regression result shown in Table 7-7 and means that 13.29 percent of the variation in cases can be explained by the subgroup C3 variables.

Table 7-7. Effect of entering variable groups separately on cases, hours, cases per hour

		Adjusted R-square for:			Adjusted R^2 as a % of total R^2		
		Cases	Hours	Cases per hour	Cases	Hours	Cases per hour
	Group Entered:						
P1	Test score	0.0030	0.0073	0.0235	0.7%	2.9%	5.7%
P2	Employment status	0.0286	0.0428	0.0095	6.7%	16.8%	2.3%
P3	Own – pay	0.0120	0.0021	0.0026	2.8%	8.7%	0.6%
P4	Demographics	0.0256	0.0275	0.0056	6.0%	10.8%	1.4%
	Sum	0.0692	0.0797	0.0412	16.2%	39.1%	10.1%
	Entire P group	0.0457	0.0668	0.0329	10.7%	26.2%	8.0%
C1	Crew – area	0.0015	0.0071	0.0163	2.7%	2.8%	4.0%
C2	Commute	0.0020	0.0107	0.0161	0.5%	4.2%	3.9%
C3	Crew – performance	0.1329	0.0443	0.0843	31.1%	17.4%	20.6%
	Sum	0.1364	0.0621	0.1167	34.3%	24.4%	28.5%
	Entire C group	0.1326	0.0589	0.1036	31.0%	23.1%	25.3%
L1	LCO – area	0.0395	-0.0002	0.0634	9.2%	-0.1%	15.5%
L2	LCO – characteristics	0.0501	0.0129	0.0521	11.7%	5.1%	12.7%
L3	LCO – dummies	0.1219	0.0804	0.1303	28.5%	31.5%	31.9%
	Sum	0.2115	0.0931	0.2458	49.5%	36.5%	60.1%
	Entire L group	0.1233	0.0793	0.1266	28.9%	31.1%	31.0%
	Hours			0.0052			1.3%
	Total	0.4171	0.2349	0.4089	100.0%	100.0%	100.0%

For analysis of individual behavior of the type displayed here, an R-square above .05 is doing quite well, and an R-square above .10 is quite high. Being able to explain anything close to 20 percent of the variation is doing extremely well. Explaining more than 20 percent of the variation in any type of individual behavior is extremely hard because it is difficult to acquire information about individual differences, and, perhaps more importantly, because there generally is a lot of "random" variation in the behavior of seemingly identical individuals.

Table 7-8. Effect of removing variable groups separately on cases, hours, cases per hour

		Adjusted R-square for:			Adjusted R^2 as a % of total R^2		
		Cases	Hours	Cases per hour	Cases	Hours	Cases per hour
	Group Removed:						
P1	Test score	0.1864	0.1526	0.1861	-1.7%	0.0%	-3.3%
P2	Employment status	0.1819	0.1366	0.1910	-4.1%	-10.5%	-0.8%
P3	Own – pay	0.1897	0.1520	0.1925	0.0%	-0.4%	0.0%
P4	Demographics	0.1770	0.1313	0.1922	-6.7%	-14.0%	-0.2%
	Sum				-12.5%	-24.8%	-4.3%
	Entire P group	0.1595	0.0994	0.1849	-15.9%	-34.9%	-3.9%
C1	Crew – area	0.1883	0.1495	0.1859	-0.7%	-2.0%	-3.4%
C2	Commute	0.1896	0.1504	0.1855	-0.1%	-1.4%	-3.6%
C3	Crew – performance	0.1629	0.1404	0.1739	-14.1%	-8.0%	-9.7%
	Sum				-14.9%	-11.5%	-16.7%
	Entire C group	0.1536	0.1354	0.1493	-19.0%	-11.3%	-22.4%
L1	LCO – area	0.1892	0.1485	0.1886	-0.3%	-2.7%	-2.0%
L2	LCO – characteristics	0.1892	0.1489	0.1893	-0.3%	-2.4%	-1.7%
L3	LCO – dummies	0.1699	0.1290	0.1645	-10.4%	-15.5%	-14.5%
	Sum				-11.0%	-20.6%	-18.2%
	Entire L group	0.1640	0.1149	0.1445	-13.5%	-24.7%	-24.9%
	Hours			0.1778			-7.6%
	Total when all groups are included	0.1897	0.1526	0.1925	0.0%	0.0%	0.0%
	R-sq all groups in as a % of sum of R-sq each R-sq group alone	45.5%	65.0%	47.1%			

In the remainder of this subsection we discuss the results for each group and subgroup in the order listed in Table 7-7. To make the discussion easier to follow, we summarize the overall effects and then discuss the results in more detail. Our summary statistics include the R-square when the group or subgroup is included, the percentage of the entire variation explained by summing the individual results in Table 7-7, and the decrease in the explanatory power when the group or subgroup is excluded from

regressions including all other variables. In discussing the explanatory power of the R-squares we use the following terms:

	R-square
Very strong	> .07
Strong	.041 - .070
Moderate	.021 - .040
Small	.011 - .020
Slight	.005 - .010
Virtually none	< .005

7.5.1 Group P. Personal Characteristics of Enumerators

The personal characteristics group (Table 7-9) has strong explanatory power in accounting for the variation in hours worked and cases. The group has moderate explanatory power on cph, but only when personal characteristics are included alone. That removing personal characteristics when all other variables are included has a small effect on cph suggests that in this one case, personal characteristics derive much of their power from correlations with other variables rather than independent effects.

Table 7-9. Personal characteristics of enumerators

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Strong Effect	.0457	10.7%	-12.5%
Hours – Strong Effect	.0668	26.2%	-24.8%
CPH – Moderate Effect	.0329	8.0%	-3.9%

7.5.1.1 Subgroup P1. Test Scores

The test score subgroup (Table 7-10) has a moderately strong effect on cph, but almost no effect on cases or hours. Several factors account for these results. Perhaps most importantly, scores have relatively small effects in 2000 because very few enumerators have scores below 80 where differences in scores make a big difference in cph. In addition, increases in scores are not associated with uniform increases in cph.

Table 7-10. Test scores

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Virtually No Effect	.0030	0.7%	-1.7%
Hours – Slight Effect	.0073	2.9%	0.0%
CPH – Moderate Effect	.0235	5.7%	-3.3%

Enumerators whose test scores exceed a threshold of about 87 have the highest cph, but the rate is about the same for all enumerators in that group. Enumerators with test scores between 80 and 87 complete about 15 percent fewer cases per hour than enumerators with the highest scores. Enumerators with test scores between 75 and 79 complete about 25 percent fewer cases per hour, and enumerators with test scores below 75 complete about 20 percent fewer cases. (We suspect that most enumerators with scores below 75, and many with scores between 75 and 87, have special language skills and English is often a second language.)

Test scores have a slight effect on hours, but in contrast to cph, the lower are the scores the greater is the number of hours worked. Enumerators with test scores below 75 work about 15 hours more than average, those with scores between 75 and 92 work about 10 hours more than average. (Those differences are statistically significant.) Because the effect of test scores on hours and cases per hour are in opposite directions (and relatively weak) the test scores have almost no ability to explain variation in cases, which is the key determinant of completion speed.

Overall, our results suggest that the Census Bureau should reassess its use of test scores to order hiring contact lists. Given that the hiring pool had many candidates with especially high scores, and above 87 or so differences in test scores have little effect on performance, it would make sense to exclude candidates with low scores (unless they have special skills) and use additional selection criteria (such as being free to work longer hours) to choose the candidates who will perform the best.

7.5.1.2 Subgroup P2. Employment Status

The number of hours enumerators worked, shown in Table 7-11, was strongly affected by enumerators' employment status at the point they began NRFU training. Strong attachment to the labor force just prior and during the NRFU reduced hours worked on the NRFU by 25 percent or more, while the reverse was true for weak labor force attachment.

Table 7-11. Employment status

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Moderate Effect	.0286	6.7%	-4.1%
Hours – Strong Effect	.0428	16.8%	-10.5%
CPH – Slight Effect	.0095	2.3%	-0.8%

Working full-time during the NRFU had very strong negative effects on hours, while not having worked within the past 3 months had a very strong positive effect. Enumerators who were retired, primarily caregivers, or otherwise not working or looking for work worked the most hours on average.

The effect on hours carried over to the total number of cases. However, there was only a very weak association between employment status and cases completed per hour.

7.5.1.3 Subgroup P3. Own Pay

Own pay (shown in Table 7-12) had moderately strong effect on hours worked, but only when other variable groups were excluded. We also determined that the association between pay and hours was negative for enumerators working at other jobs when they began enumerator training. However, the association between pay and hours was positive for enumerators who had stopped working within 3 months, and especially large and positive for enumerators who had not worked for at least 3 months. These results are much in keeping with expectations because only when an enumerator also was at work at another job would we expect the pay of that job to strongly affect hours worked on the NRFU.

Table 7-12. Own pay

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Slight Effect	.0120	2.8%	0.0%
Hours – Moderate Effect	.0221	8.7%	-0.4%
CPH – Virtually No Effect	.0026	0.6%	0.0%

Thus, our overall conclusion is that an enumerator's pay at other jobs is only an indicator of "opportunity cost" for those working at other jobs during the NRFU.[9] In contrast, own pay appears to be an indicator of the enumerator's effectiveness for those not working. That is, the higher the pay enumerators earned at other jobs, the slightly better is the enumerators performance on the NRFU in terms of working more hours and completing more cases per hour.

7.5.1.4 Subgroup P4. Demographics

While we will not be discussing the specific demographic characteristics that affect cases, hours, or cph, it is important to recognize that demographic characteristics have a substantial effect on hours of work (and through its effect on hours on cases completed).

Importantly, the large reductions in explanatory power when the demographic subgroup is excluded indicate that several demographic characteristics have strong explanatory power that is not captured by any other variables in our regressions. (See Table 7-13.) Thus, excluding demographic variables entirely from the regressions would substantially reduce our ability to estimate performance, and even more importantly, severely bias the coefficients on some of the remaining variables.

[9] Importantly, our surveys showed that the vast majority of enumerators working at the point training began also planned to continue working during NRFU field operations. We used the employment status at the time training began in our regressions because we felt that this information could be obtained at the point offers were made and possibly used as a hiring screen.

Table 7-13. Demographics

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Moderate Effect	.0256	6.0%	-6.7%
Hours – Moderate Effect	.0275	10.8%	-14.0%
CPH – Small Effect	.0056	1.4%	-0.2%

7.5.2 Group C. Crew Characteristics

The crew characteristic group (Table 7-14) has very strong explanatory power on cases completed and cph, and strong explanatory power on hours worked. As will be discussed below, most of the explanatory power resides in subgroup C3, which describes the amount of work other crew members were able to complete. The effect is especially powerful on cases and hours.

Table 7-14. Group C. crew characteristics

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Very Strong Effect	.1326	31.0%	-19.0%
Hours – Strong Effect	.0589	23.1%	-11.3%
CPH – Very Strong Effect	.1036	25.3%	-22.4%

That the decline in the effect when Group C variables are excluded is a little less than half as great as the increase when the variables are included suggests that about half of the explanatory power is due to the independent effect of these variables, but half is a result of a high degree of correlation with other variables. This intercorrelation is examined in great detail in connection with describing Table 7-22 in a subsequent section.

7.5.2.1 Subgroup C1. Crew Area Characteristics

Variation in the characteristics of the areas in which a crew worked had little effect on NRFU performance. Nevertheless, our results suggest that it was most difficult for crews to complete

cases in areas with many large apartment buildings and easiest to complete cases in areas with mostly moderate and some high-income residents. (See Table 7-15.)

Since this was the first time we knew the characteristics of the area in which enumerators worked, we were able to test the hypothesis that area differences had large effects, particularly on cases per hour. These negative findings, however, coupled with our evidence (discussed below) that LCO dummies had strong effects suggests LCO-level management attributes were much more important determinants of NRFU performance than the characteristics of where enumerators worked. If our somewhat speculative conclusion is true, this is a very important result because it suggests that local managers had all the tools needed to meet NRFU goals, and good management practices could overcome negative neighborhood differences.

Table 7-15. Subgroup C1. crew area characteristics

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Small Effect	.0115	2.7%	-0.7%
Hours – Slight Effect	.0071	2.8%	-2.0%
CPH – Small Effect	.0163	4.0%	-3.4%

7.5.2.2 Subgroup C2. Commuting Characteristics

Longer commuting time had a slightly negative effect on productivity and hours worked, but we could find no evidence that working in one's own neighborhood had a positive effect on cases per hour or hours worked (holding commuting time constant). Indeed, productivity was about 10 percent greater for enumerators working in a similar neighborhood, rather than one's own neighborhood (Table 7-16). Thus, on balance, it appears that broadening the geographic area over which selections are made would enhance performance.

Table 7-16. Subgroup C2. commuting characteristics

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Virtually No Effect	.0020	0.5%	-0.1%
Hours – Slight Effect	.0107	4.2%	-1.4%
CPH – Slight Effect	.0161	3.9%	-3.6%

7.5.2.3 Subgroup C3. Crew Performance Characteristics

The crew performance group included only three variables:

- Number of cases completed by *other* crew members by the end of week 4;
- Maximum number of crew members at work in weeks 1-4; and
- Percentage of cases completed by the end of week 4.

As shown in Table 7-17, this group had very strong explanatory power when entered alone. The explanatory power of our regression also was substantially reduced when the subgroup C3 variables were excluded and all other variables included. However, that the exclusion effects were considerably smaller than the inclusion effects suggests that there was substantial intercorrelation with other variables. As noted earlier, we discuss this intercorrelation in detail in a subsequent section.

Table 7-17. Subgroup C3. crew performance characteristics

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Very Strong Effect	.1329	31.1%	-14.1%
Hours – Strong Effect	.0443	17.4%	-8.0%
CPH – Very Strong Effect	.0843	20.6%	-9.7%

That the amount of work made available to a given crew and the rate at which the crew completed its work had a powerful effect on individual performance may seem an obvious result. However, it is important to keep in mind that in prior NRFUs these variables were highly unlikely to have had much of an effect because fewer enumerators were planned to be at work at any one time, and

retaining enumerators proved very difficult. Thus, there was virtually no limit to the amount of work a given enumerator could complete within the first 4 weeks.

While a better variable would be the number of cases assigned to a given crew at the start of the NRFU, we believe that it is appropriate to hold constant the differences in the amount of work and pace of work of crewmembers other than the person being studied. It is our view that the crew–performance variables demonstrate that LCO managers established a high degree of control over the pace of operations in 2000 (that was absent in prior NRFUs).

7.5.3 Group L. LCO Characteristics

As shown in Table 7-18, characteristics of the LCO that managers had no control over (prevailing pay and population density), and characteristics managers had at least some control over (census pay, LCOM turnover, and hiring goals) had strong effects on cases completed per hour and total cases completed per enumerator.

Table 7-18. Group L. LCO characteristics

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Very Strong Effect	.1233	28.9%	-13.5%
Hours – Very Strong Effect	.0793	31.1%	-24.7%
CPH – Very Strong Effect	.1266	31.0%	-24.9%

These strong correlations suggest that LCOs in high-wage, high-density areas (mainly central cities) had a more difficult time executing the NRFU. The precise reason is not revealed by these results, but we speculate that it was inherently more difficult to canvass urban populations and more difficult to manage the staff in those areas, in large part because the number of cases to complete and number of enumerators at work were much greater in urban LCOs than other LCOs, especially those in rural areas.

7.5.3.1 Subgroup L1. LCO Area Characteristics and Subgroup L2. LCO Characteristics

As shown in Tables 7-19 and 7-20 there was a much weaker correlation between hours and LCO area characteristics, and between hours and LCO characteristics controlled by the Census Bureau These results also are in keeping with expectations because having a more difficult task might elicit greater hours of work by enumerators.

Table 7-19. Subgroup L1. LCO area characteristics

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Moderate Effect	.0395	9.2%	-0.3%
Hours – No Effect	-.0002	-0.1%	-2.7%
CPH – Strong Effect	.0634	15.5%	-2.0%

Table 7-20. Subgroup L2. LCO characteristics

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Strong Effect	.0501	11.7%	-0.3%
Hours – Small Effect	.0129	5.1%	-2.4%
CPH – Strong Effect	.0521	12.7%	-1.7%

However, a particularly interesting result is that excluding the variables in subgroups L1 and L2 had only a small effect on the explanatory power of our regressions. This is evidence that other variables in our specification were highly correlated with these two subgroups. A separate analysis points to the LCO dummies having almost all of this intercorrelation. This is hardly surprising, given that LCO dummies would capture the effect of the characteristics identified in our database as well as variables we were unable to include.

7.5.3.2 Subgroup L3. LCO Dummies

The strong explanatory power of the LCO dummies indicates that all crews working in a given LCO had similar performance, and different performance from crews in other LCOs. These

variables (Table 7-21) do not tell us the source of the large cross-LCO differences, but those differences could stem from differences in management performance and practices, difficulty in executing the work associated with types of residences to be visited, or characteristics of the recruiting pool.

Table 7-21. Subgroup L3. LCO dummies

	R-square	Inclusion percent explained	Exclusion percent explained
Cases – Very Strong Effect	.1219	28.5%	-10.4%
Hours – Very Strong Effect	.0804	31.5%	-15.5%
CPH – Very Strong Effect	.1303	31.9%	-14.5%

7.6 Further Analysis of the Explanatory Power of Each Subgroup

In this subsection we use an alternative measure of explanatory power to obtain additional information about the association between cases, hours, and cases per hour and each subgroup. This alternative measure was suggested by Ed Funkhauser, a professor at the University of California, Santa Barbara, who reviewed an earlier version of this report. The alternative to use of the R-square is derived as follows. First, we separately calculate the mean values of each variable used in our regressions for enumerators with above average and below average performance for each of the three dependent variables. Second, we calculate the difference in the mean values for each variable. Third, we multiply the mean difference times the coefficient itself. Finally, the products are summed by subgroup, group, and all groups together.

Dividing the group and subgroup sums by the total for all groups together provides a measure of the percentage of the total explanatory power attributable to each group and subgroup. For example, in the top of the cases section of Table 7-22, the three strongest groups account for 75.4 percent of all the explained variance.

Dividing the total for all groups by the difference in the mean of the dependent variables (for enumerators with above and below performance) provides a measure of the total amount of variation explained by each regression specification. For example, we see at the bottom of Table 7-22 that

Table 7-22. Each group's contribution to explaining the difference between above average and below average: Cases, hours, cases per hour using four regression specifications: with/without crew performance and LCO dummies

	Cases (% of specification 1's total explanatory power)					**Hours** (% of specification 1's total explanatory power)					**Cases per hour** (% of specification 1a's total explanatory power)				
Specification	1	2	3	4		1	2	3	4		1	1a	2a	3a	4a
A. Groups with Greatest Explanatory Power															
crew-perf	41.2%	55.9%			LCO dum	19.5%		7.1%		LCO char	28.0%	24.3%	23.1%	20.8%	35.6%
LCO dum	33.2%		57.9%		Crew-perf	15.8%	25.2%			crew-perf	22.4%	23.9%	30.1%		
LCO-char	0.9%	11.2%	2.3%	28.5%	LCO char	12.9%	6.4%	17.3%	8.3%	LCO dum	21.3%	23.7%		42.8%	
	75.4%	67.1%	60.2%	28.5%		48.2%	31.6%	24.4%	8.3%		71.7%	71.9%	53.2%	63.5%	35.6%
B. Groups with Second Most Explanatory Power															
demo	10.2%	10.4%	10.4%	11.3%	Emp-stat	20.9%	21.2%	21.6%	22.6%	hours		8.0%	8.7%	7.3%	7.2%
emp-stat	9.9%	9.6%	10.6%	11.0%	Demo	19.0%	17.1%	19.1%	17.9%	score	7.6%	7.3%	8.0%	7.6%	8.4%
	20.1%	19.9%	21.0%	22.3%		39.9%	38.3%	40.7%	40.5%		7.6%	15.3%	16.7%	14.9%	15.6%
C. Groups with Least Explanatory Power										commute	5.2%	4.8%	4.7%	5.1%	4.7%
crew-area	2.4%	2.4%	3.1%	3.3%	Commute	3.6%	4.8%	3.5%	5.1%	crew area	4.5%	4.2%	5.0%	5.7%	6.2%
score	1.4%	1.5%	1.5%	1.6%	Crew area	3.6%	5.4%	3.4%	5.5%	emp-stat	3.6%	3.3%	3.6%	3.1%	3.5%
own-pay	1.2%	1.3%	1.1%	1.5%	Own pay	3.4%	4.3%	3.4%	4.7%	own pay	0.7%	0.5%	0.7%	0.7%	1.0%
commute	-0.5%	-0.4%	-0.6%	-0.3%	Score	1.3%	3.0%	1.2%	3.7%	demo	0.0%	0.0%	0.7%	0.0%	0.8%
	4.5%	4.9%	5.1%	6.0%		12.0%	17.5%	11.4%	18.9%		14.0%	12.8%	14.8%	14.7%	16.2%
	100.0%	91.9%	86.3%	56.8%		100.0%	87.4%	76.5%	67.7%		93.2%	100.0%	84.6%	93.1%	67.5%
Explained Variance					Explained Variance					Explained Variance					
Cases	24.3	22.3	20.9	13.8	Hours	13.5	11.8	10.3	9.1	Cases/Hour	0.160	0.171	0.145	0.160	0.116
% of total	22.9%	21.0%	19.7%	13.0%	% of total	17.5%	15.3%	13.4%	11.9%	% of total	21.4%	23.0%	19.4%	21.4%	15.5%
Relative to specification 1	0.0%	-8.1%	-13.7%	-43.2%	Relative to specification 1	0.0%	-12.6%	-23.5%	-32.3%	Relative to specification 1	-6.8%	0.0%	-15.4%	-6.9%	-32.5%
R-square	0.189	0.170	0.163	0.099	R-square	0.152	0.129	0.140	0.093	R-square	0.178	0.192	0.165	0.174	0.124
R-sq relative to specification 1	0.0%	-10.2%	-13.9%	-47.6%	R-sq relative to specification 1	0.0%	-15.1%	-7.6%	-38.8%	R-sq relative to specification 1a	-7.4%	0.0%	-14.3%	-9.4%	-35.3%

Note: All specifications are identical except hours were included to specifications for cases per hour denoted as 1a, 2a, etc.

All percentages are relative to total variance explained by specification 1 for cases and hours, and 1a for cases per hour.

Contribution to explained variance is estimated by multiplying the regression coefficient for each variable in each specification times the difference in that variable's mean for above-average versus below-average enumerators, and then summing the results for variables in each group.

Specification 1 includes all variables, Specification 2 omits LCO dummies, Specification 3 omits crew performance, Specification 4 omits LCO dummies and crew performance. Specification 1 (for cases per hour) excludes hours, which were included in all other specifications for cases per hour.

specification 1 produces an estimate of the difference in cases between those with above and below average performance equal to 24.3 cases, which is 22.9 percent of the difference in the means for the two groups. (The difference in mean cases for the two groups is quite substantial, 105.3 cases.)

The estimates of explanatory power derived from the alternative method are a bit greater than the estimates derived from using the R-squares for cases regressions, but slightly smaller for the other dependent variables. Importantly, the two different measures of explanatory power are similar to each other. This suggests that the two measures produce comparable results overall. However, a key advantage to using the alternative measure is the relative ease in examining how the explanatory power of the groups and subgroups change when the specifications are changed.

In this subsection we use four specifications to assess the intercorrelation among the LCO dummies (subgroup L3), the crew performance measures (subgroup C3), and the remaining variables. But first, we discuss the overall effect of altering the basic specification (specification 1) by:

- Removing the LCO dummies alone (to create specification 2);
- Removing crew performance variables alone (to create specification 3); and
- Removing both LCO dummies and crew performance variables (to create specification 4).

The regression specifications used to examine cases and hours are identical, but we added five variables describing the number of hours enumerators worked when examining cases-per-hour[10]. This was done because the amount of work planned for a given enumerator to execute varied across crews and LCOs. Enumerators having to perform more work would likely have to work more hours, and many of the hours would have been at times when productivity (cases per hour) would be relatively low. Thus, it made sense to hold hours of work constant (given that hours were at least partly under the control of census managers).

At the right side of Table 7-22 we see that adding the five hours variables to the cases per hour regression increased the explanatory power of the basic specification by about 7 percent (measured using the R-square or percent of variation estimated using the alternative specification). Also in keeping with expectations, the gain in overall power was associated with a reduction in the explanatory power of

[10] The five variables provided separate estimates for the effect on cases completed per hour of working 1-25 hours, 26-75 hours, 76-125 hours, 126-200 hours, more than 200 hours.

variables describing LCO characteristics that were under the control of census managers. (The explanatory power of LCO characteristics fell from 28.0 percent to 24.3 percent.)

The main effect of eliminating variable subgroup L3 and C3 on the explanatory power of the alternative specifications are summarized in Table 7-23.

Table 7-23. Effect of eliminating subgroups l3 and C3 on the explanatory power of the basic specification

	% reduction in explanatory power of specification 1			
Specification	1	2	3	4
L3. LCO dummies	Y	N	Y	N
C3. Crew performance	Y	Y	N	N
Cases	0.0	-8.1	-13.7	-43.2
Hours	0.0	-12.6	-23.5	-32.3
Cph	0.0	-15.4	-6.9	-32.5

In all cases, removing both LCO dummies and crew performance variables sharply reduced the explanatory power of the regressions. Also, the effect of removing them both was always much greater than eliminating either one individually. However, the magnitude of the effects differed across the dependent variables.

With respect to cases, the individual reductions were especially small relative to the effect of removing both subgroups together. The sum of the reductions of eliminating each one separately was only about half of the reduction when both were eliminated. This suggests that whatever underlying factors were at work, both sets of variables individually captured those effects.

With respect to hours, the individual removal effects were large, and the sum was slightly greater than the effect of removing them both at the same time. This suggests that whatever factors affected hours, the effects of the two subgroups were quite independent.

With respect to cases per hour, the effects of separately removing the two variable groups were about equal, but opposite to the effect on cases. The effect of removing both together was relatively modest.

Before drawing additional conclusions from these results, we discuss the effects of the individual subgroups for the different specifications as well as the effect of changing the specifications for each dependent variable.

7.6.1 Analysis of Subgroups with the Highest Explanatory Power

Using the basic specification for each dependent variable, three subgroups together—LCO dummies, crew performance, LCO characteristics—showed high explanatory power, *and* especially strong interactions with each other. As shown in column 1 of Table 7-24, the "top-3" variables explained more than 70 percent of the variation in cases and cph, and close to 50 percent of the variation in hours.

Column 2 of Table 7-24 shows that when the crew performance and LCO dummy subgroups were included, the LCO characteristic subgroup explained more than one-quarter of the variation in cph, about half as much variation in hours, and had almost no explanatory power for cases.

Table 7-24. Explanatory power of top three variables and LCO characteristics with inclusion/exclusion of LCO dummies and crew performance variables

	Explanatory Power of:				
	Top variables	LCO characteristics alone			
Specification	1a	1	2	3	4
Inclusion/Exclusion					
LCO dummies	Yes	Yes	No	Yes	No
Crew performance	Yes	Yes	Yes	No	No
Explanatory Power					
Cases	75.4%	0.9%	11.2%	2.3%	28.5%
Hours	48.2%	12.9%	6.4%	17.3%	8.3%
Cases per hour*	71.7%	28.0%	24.3%	20.8%	35.6%

* In estimating cases per hour, the 5 hours variables were included making the specifications 1a through 4a.

However, when both the LCO dummies and crew performance subgroups are removed (specification 4), the LCO characteristics variables dramatically increased their explanatory power with respect to cases and cph, but the explanatory power fell with respect to hours. The hours results are particularly interesting because removing the crew performance subgroup alone (specification 3)

dramatically increased the explanatory power of the LCO characteristics, (and dramatically reduced the explanatory power of the LCO dummies). In contrast, removing crew performance alone increased the power of the LCO dummies in explaining variation in cases per hour, while slightly lowering the already high explanatory power of LCO characteristics.

These results are consistent with the view that how the LCO was managed strongly influenced the crews' performance in terms of hours, which we would expect to be most under the control of Census Bureau managers. (By contrast, cases per hour would largely be a function of the characteristics of the enumerators and areas in which they worked.) It also reinforces similar evidence from our recently completed recruiting study that factors under the control of census officials at the headquarters, region, and/or local level had major influences on recruiting performance. Thus, in the final analysis, the influence of management on cases completed is primarily through its influence of hours worked by each enumerator.

7.6.2 Analysis of the Subgroups with the "Next Highest" Explanatory Power

Section B of Table 7-22 shows the subgroups with strong explanatory power but notably less explanatory power than the top three, especially on cases and cases per hour. The employment status subgroup and the demographic variable subgroup have especially strong explanatory power on hours. Importantly, as summarized in Table 7-25, these two subgroups account for about 40 percent of the variation regardless of whether the LCO dummy and crew performance subgroups are included or excluded.

These result are in keeping with expectations because the number of hours worked by enumerators should be highly constrained among enumerators working at non-census jobs, but largely unconstrained among enumerators who are retired or have few family responsibilities. Similarly, several of the demographic characteristics are likely to be correlated with the likelihood that enumerators have other demands on their time.

Employment status and demographic subgroups explain only about half as much variation as with cases as with hours. However, they also are insensitive to the inclusion or exclusion of LCO dummies and crew performance variables. The interrelationship between large hours effects and less large cases effects are expected because cases equals hours times cases per hour. Cases effects are only about

half as great as the hours effects because enumerators with above average cases per hour usually do not work above average numbers of hours.

Table 7-25. Variables with next highest explanatory power *for cases and hours*:

	Employment-status and demographics	
Specification	1	4
Cases – much lower	20.9%	22.3%
Hours – by far highest	39.9%	40.5%
Cph – very low	3.3%	4.4%

As shown above, employment status and demographic characteristics have almost no effect on cases per hour, and therefore are relegated to the group with the least explanatory power. Hours and test scores are the two subgroups with the largest effect on cases per hour. The effects of the two variables are about equal and total about 15 percent. These effects also are largely the same across all four specifications.

As discussed earlier, we expect that hours would affect cases per hour not simply because of a mathematical identity, but because enumerators working many hours would invariably be working during less productive periods. In addition, we speculate that those enumerators working the most hours eventually got assigned to complete the most difficult cases.

The influence of test scores also is in keeping with expectations because the attributes needed to do well on the test (such as ability to read maps and perform clerical tasks) are likely to be highly relevant to quickly performing enumerators' tasks. At the same time, it also makes sense that scores have only small effects on cases and hours. While crew leaders might want to reward enumerators who work most effectively per hour by giving them more cases to complete, other factors, particularly the amount of free time available to an enumerator, would strongly affect enumerators' abilities to accept those offers. Thus, the total cases completed by an enumerator are strongly affected by hours worked, and hardly at all affected by cases completed per hour.

7.6.3 Analysis Subgroups with the Least Explanatory Power

The variables listed in section C of Table 7-22 have relatively little explanatory power with respect to cases across all specifications. The explanatory power is over twice as great for hours and cases per hour, and especially large when LCO dummies alone are omitted for hours, and both LCO dummies and crew performance variables are omitted for cases per hour.

However, the total effect is due to several subgroups having about equally low explanatory power, and a few having almost no explanatory power. Crew area characteristics are of modest importance, particularly when both LCO dummies and LCO characteristics are dropped. Increased commuting time reduces both hours and cases per hour.

It is worth noting, however, that the effect of enumerators' own prior pay is about equal to the effect of other section C subgroups only for hours. This result makes sense because the opportunity cost would most strongly affect hours of work, and also because our in-depth analysis suggests that high pay at alternative jobs has a strong effect, but only for enumerators who are working full-time during the NRFU.

7.6.4 Summary of the Subgroups Analysis

This analysis shows that the explanatory power of our specification, including the LCO dummy and crew performance subgroups, is quite respectable. We, therefore, conclude that the information contained in these regressions could be used to improve enumerator performance, even though a lot of variance cannot be explained.

Perhaps most importantly, the use of alternative specifications shows that removing the LCO dummies and crew performance subgroups dramatically reduces the explanatory power of the regressions. However, some of this reduction is offset by an increase in the explanatory power of the LCO characteristics.

It is our view that the importance of the LCO dummies, LCO characteristics, and crew performance subgroups suggest that factors under the control of census managers had a major influence on performance. More specifically, we believe that these results are consistent with the view that

management practices and performance has a much stronger effect on completion speed than variables outside the control of Census Bureau management. Thus, good management practices could enable crews (and LCOs) to overcome negative influences stemming from variation in the characteristics of the area itself (such as the presence of many high-income apartment dwellers) or the enumerator pool (such as many candidates being selected who were working at full-time, high-paying jobs).

7.7 Analysis of the Explanatory Power of Individual Variables

To conclude the description of what we learned from the alternative method of assessing the explanatory power of different regression specifications, we examine in some detail the contribution of each individual variable to the overall explanatory power and the source of the contribution. We do this by displaying the effect of each explanatory variable on our prediction of each of the three dependent variables—cases, hours, and cases per hour. We also decompose the net effect into two components:

- The effect of the size of the difference in mean of each explanatory variable between enumerators with above average and below average performance for the corresponding dependent variable.
- The effect of the size of each dependent variable's regression coefficient.

7.7.1 Individual Variables' Effect on Cases

Column A1 of Table 7-26 describes the contribution of each dependent variable to explaining differences in cases completed. This contribution is the product of the difference in means (shown in column B3) and the regression coefficient (shown in column C1). The explanatory variables are placed in their respective subgroups. We indicate by shading and bolding the 10 variables with the highest explanatory power, and by shading alone the 10 variables with next highest explanatory power. Column A2 displays the ranking of the power of each variable based on its absolute value in column A1. Negative signs in front of the rankings indicate a variable reduces the difference between above average and below average enumerators.

Two of the three variables in subgroup C3, crew performance, shown at the very end of Table 7-26, are in first and second place. The LCO dummy for Gadsden, Alabama (variable 59) is in third place, and four of the variables in the LCO area subgroup are in fourth through seventh place.

Table 7-26. The effect of various variables on cases completed using specification 1 and the mean difference between above average and below average enumerators

	Variable type	Change in cases (difference in means x coefficient) (B1-B2) X C1	Rank of change	Means: Above average	Means: Below average	Means: Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
	(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
P1. Test Scores											
1 < 75	0/1	-0.019	-62	0.049	0.046	0.003	-52	5.8%	-6.98	-32	0.372
2 75-79	0/1	0.423	22	0.055	0.083	-0.028	20	-33.6%	-15.21	17	0.031
3 80-84	0/1	-0.004	-70	0.108	0.107	0.000	-58	0.4%	-9.37	-27	0.146
4 85-89	0/1	0.002	72	0.156	0.158	-0.002	54	-1.2%	-1.13	54	0.851
5 90-91	0/1	0.089	45	0.082	0.070	0.012	33	17.2%	7.40	31	0.276
6 92-93	0/1	-0.146	-34	0.192	0.166	0.025	-21	15.3%	-5.74	-38	0.326
7 94-95	0/1	0.004	69	0.108	0.114	-0.006	44	-5.1%	-0.73	55	0.906
8 96-97	0/1	0.004	71	0.113	0.107	0.006	46	5.3%	0.65	56	0.916
9 98-100	0/1	-0.006	-68	0.080	0.091	-0.012	34	-12.8%	0.49	-57	0.940
(score 101+ omitted)		0.348	57			-0.001					
P2. Employment Status											
10 Worked +35 hr last week	0/1	0.581	16	0.170	0.257	**-0.087**		-33.8%	-6.70	34	0.193
11 Worked +35 hr 2-12 weeks ago	0/1	0.044	55	0.045	0.055	-0.010	38	-17.5%	-4.59	43	0.518
12 Worked +35 hr 13+ weeks ago	0/1	0.035	57	0.038	0.035	0.003	53	7.4%	13.32	21	0.075
13 Worked <35 hr last week	0/1	-0.002	-73	0.089	0.095	-0.006	-45	-6.0%	0.36	-58	0.951
14 Worked <35 hr 2-12 weeks ago	0/1	-0.009	-65	0.038	0.034	0.004	-50	13.4%	-1.95	-50	0.799
15 Worked <35 hr 13+ weeks ago	0/1	0.310	26	0.027	0.014	0.013	29	91.9%	**23.65**		0.011
16 Self-empl. in last 12 weeks	0/1	0.058	54	0.065	0.052	0.012	31	23.7%	4.67	42	0.477
17 Self-empl. 13+ weeks ago	0/1	0.100	43	0.016	0.008	0.008	41	97.1%	12.78	23	0.286
18 Looking for work within 12 weeks	0/1	0.027	60	0.032	0.037	-0.005	47	-14.6%	-4.94	41	0.516
19 Looking for work13+ weeks ago	0/1	0.082	47	0.052	0.042	0.010	37	23.5%	8.27	29	0.227
20 Retired	0/1	0.401	23	0.172	0.112	**0.059**		52.6%	6.78	33	0.228
21 Not-working or looking	0/1	0.169	31	0.033	0.024	0.008	40	35.1%	19.89		0.015
22 Caregiver in last 12 weeks	0/1	0.123	39	0.030	0.021	0.009	39	42.4%	13.72		0.121
23 Caregiver 13+ weeks ago	0/1	0.523	20	0.059	0.036	0.023	24	64.4%	**22.52**		0.001
24 Student	0/1	-0.042	-56	0.044	0.080	-0.035		-44.4%	1.18	-53	0.858
(employment status unknown omitted)		2.400	44			0.007					

Table 7-26. The effect of various variables on cases completed using specification 1 and the mean difference between above average and below average enumerators (continued)

		Change in cases (difference in means x coefficient)		Means							
	Variable type	(B1-B2) X C1	Rank of change	Above average	Below average	Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
	(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
P3. Hourly Pay, Prior Job											
25 Hourly pay, worked last week	cont.	0.150	33	4.098	5.423	-1.325		-24.4%	-0.11		0.523
26 Hourly pay, worked 2-12 wks ago	cont.	0.077	48	2.008	1.689	0.319		18.9%	0.24		0.324
27 Hourly pay, worked 13+ wks ago	cont.	0.066	51	5.354	4.089	1.265		30.9%	0.05		0.717
		0.293	44			0.259					
C1. Crew Area											
28 Farms > 25%	0/1	-0.010	-64	0.114	0.113	0.001	-57	0.9%	-10.30	-26	0.211
29 Single family homes + farms > 75%	0/1	-0.154	-32	0.509	0.450	**0.059**	**-5**	13.1%	-2.61	-47	0.717
30 Apartments > 50%	0/1	0.060	52	0.078	0.111	-0.033	17	-30.0%	-1.81	51	0.829
31 Housing—none of the above	0/1	0.058	53	0.156	0.178	-0.022	25	-12.2%	-2.66	46	0.731
32 Low income > 50%	0/1	0.029	59	0.392	0.380	0.012	35	3.0%	2.48	48	0.727
33 High income > 50%	0/1	0.302	27	0.155	0.205	**-0.050**	**8**	-24.5%	-6.01	35	0.421
34 Moderate income >50, high>25	0/1	0.108	41	0.130	0.106	0.024	23	22.4%	4.55	44	0.555
35 Moderate income >50, low>25	0/1	-0.006	-67	0.088	0.089	-0.001	-56	-1.1%	5.86	-36	0.466
36 Income—none of the above	0/1	0.125	38	0.085	0.063	0.022	26	34.0%	5.79	37	0.483
37 Original crew-leader stayed	0/1	0.072	50	0.611	0.592	0.019	27	3.2%	3.79	45	0.185
(crew area unknown omitted)		0.584	48			0.029					
L1. LCO Area											
38 Prevailing pay	cont.	**2.329**	**6**	15.62	16.83	-1.202		-7.1%	-1.94		0.188
39 Pop. per square mile	cont.	**-2.372**	**-5**	694.1	1137.5	-443.4		-39.0%	0.01		0.511
40 Census pay rate	cont.	0.386	24	12.32	12.97	-0.649		-5.0%	-0.59		0.695
41 Recruiting target	cont.	**2.033**	**7**	4332.9	4622.5	-289.6		-6.3%	-0.01		0.294
42 Applications in Feb as % of target	cont.	**-2.459**	**-4**	1.127	1.040	0.087		8.4%	-28.13		0.212
43 Original LCOM left	0/1	0.311	25	0.053	0.111	**-0.058**	**6**	-52.0%	-5.40	40	0.531
		0.227	12			-734.809					

Table 7-26. The effect of various variables on cases completed using specification 1 and the mean difference between above average and below average enumerators (continued)

		Change in cases (difference in means x coefficient)		Means							
	Variable type	(B1-B2) X C1	Rank of change	Above average	Below average	Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
	(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
C2. Commuting											
44 Worked in area like own, but not own	0/1	-0.087	-46	0.370	0.325	0.044	-11	13.6%	-1.98	-49	0.699
45 Worked in area unlike own	0/1	0.017	63	0.214	0.203	0.011	36	5.3%	1.54	52	0.807
46 Commuting time, worked in own area	cont.	0.104	42	4.441	5.175	-0.734		-14.2%	-0.14		0.560
47 Commuting time, worked in like area	cont.	-0.129	-37	6.029	5.358	0.671		12.5%	-0.19		0.362
48 Commuting time, worked in unlike area	cont.	-0.035	-58	4.273	4.148	0.125		3.0%	-0.28		0.235
		-0.130	49			0.117					
L3. LCO dummies											
49 New York NE	0/1	-0.183	-30	0.007	0.019	-0.012	-32	-63.3%	14.99	-18	0.471
50 New York NW	0/1	-0.220	-29	0.007	0.012	-0.005	-48	-43.1%	**41.11**	**-2**	0.276
51 Queens NE	0/1	**0.770**	**10**	0.007	0.037	-0.030	19	-81.0%	**-25.52**	**3**	0.554
52 Midland MI	0/1	0.517	21	0.080	0.057	0.024	22	42.4%	**21.59**	**9**	0.087
53 Clarksville IN	0/1	0.713	13	0.059	0.026	0.033	18	127.1%	**21.51**	**10**	0.013
54 LaCrosse WI	0/1	0.291	28	0.023	0.036	-0.013	30	-36.2%	**-22.31**	**8**	0.025
55 Minneapolis	0/1	0.641	15	0.004	0.053	**-0.049**	**9**	-91.7%	-13.09	22	0.291
56 St. Paul MN	0/1	0.074	49	0.002	0.009	-0.007	43	-79.7%	-10.75	24	0.658
57 Concord CA	0/1	0.119	40	0.045	0.040	0.005	49	11.7%	**25.16**	**4**	0.299
58 Rock Hill SC	0/1	0.143	35	0.028	0.020	0.008	42	38.0%	18.33	14	0.200
59 Gadsden AL	0/1	**2.718**	**3**	0.065	0.016	**0.048**	**10**	299.7%	**56.16**	**1**	<.0001
60 Laredo TX	0/1	-0.090	-44	0.046	0.050	-0.004	-51	-7.5%	**24.28**	**-5**	0.397
61 Phoenix North	0/1	0.718	12	0.099	0.065	0.034	15	51.8%	21.23	11	0.289
62 Scottsdale AZ	0/1	0.706	14	0.093	0.059	0.034	14	57.3%	20.87	12	0.184
63 LA Downtown	0/1	0.578	17	0.018	0.057	-0.039	12	-69.1%	-14.65	19	0.134
64 Woodland Hills CA	0/1	0.560	19	0.061	0.027	0.034	16	123.2%	16.62	15	0.038
		8.056	24			0.059					

Table 7-26. The effect of various variables on cases completed using specification 1 and the mean difference between above average and below average enumerators (continued)

		Change in cases (difference in means x coefficient)		Means							
	Variable type	(B1-B2) X C1	Rank of change	Above average	Below average	Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
	(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
P4. Demographics											
65 dem1 (g)	0/1	0.007	66	0.618	0.619	-0.001	55	-0.2%	-5.54	39	0.038
66 dem2 (y)	0/1	**1.676**	**8**	0.120	0.225	**-0.105**	**1**	-46.5%	-16.02	16	0.001
67 dem3 (o)	0/1	0.734	11	0.326	0.236	**0.090**	**2**	38.2%	8.13	30	0.119
68 dem4 (z)	0/1	-0.134	-36	0.953	0.938	0.015	-28	1.6%	-8.78	-28	0.119
69 dem5 (p)	0/1	-0.574	-18	0.253	0.199	**0.054**	**-7**	27.2%	-10.60	-25	0.021
70 dem6 (a)	cont.	**0.775**	**9**	46.3	41.5	**4.8**		11.5%	0.16		0.375
		2.484	25								
C3. Crew Performance											
71 Cases by wk5 other crew members	cont.	**7.217**	**1**	1130.4	927.7	202.7		21.8%	0.04		<.0001
72 Maximum number of crew members	cont.	-0.023	-61	9.268	9.263	0.005		0.0%	-5.08		<.0001
73 %cases others completed by wk5	cont.	**2.813**	**2**	0.856	0.821	0.035		4.3%	80.55		<.0001
		10.007	21								
Estimated differences in cases		24.3	N	1131	1610			mean cases	105.6		
Actual difference in cases		106.1	Cases	167.9	61.8			adj. R-sq	0.1893		
Percent explained		22.9%									

Notes: Ranking based on absolute value of relevant variable. Negative signs indicate effect of variable reduces difference between above and below average enumerators.

Ranking on means and coefficients provided only for 0/1 variables. The differences in the units of continuous variables makes rankings unmeaningful.

Shading in column 1 indicates continuous variables; shading in columns A1-A2 indicates top 20 variables with respect to effect on cases, bolding indicates top 10.

Shading in columns B3-B4 indicates top 20 with respect to differences in 0/1 variable means for above/below average enumerators, bolding indicates top 10.

Shading in columns C1-C2 indicates top 20 with respect to differences in coefficients (for 0/1 variables only), bold indicates top 10.

Shading in column C3 indicates coefficient (in col C1) is statistically different from 0 at least at the 5 percent level.

27 LCOs are included in this study. Because of the strong interaction between LCO dummies and LCO area, we omitted dummies for:

Stamford CT, Flint MI, Saginaw MI, Cincinnati OH, Rochester MN, Oakland CA, San Francisco-NE, Covington KY, Charlotte NC, Monroe NC, Birmingham AL, Newnan GA, Phoenix-S, and Pasadena CA. These LCOs were selected to be omitted because they had the smallest regression coefficients.

One of the chief reasons for including this table is that we can determine for each variable the extent to which its power is derived from having a large difference in its mean value for enumerators completing an above-average number of cases versus a below-average number of cases; and/or from having an especially large regression coefficient.

Knowledge of which variables show large differences in means tells us what characteristics differentiate enumerators completing many cases from those completing few cases. To highlight these differences, we indicated the 10 largest differences in means for 0/1 variables by shading and bolding, and the next 10 by shading alone. We also show the rank of each 0/1 variable in column B4. Thus, three demographic differences are ranked 1, 2, and 7 in their ability to distinguish enumerators completing many cases from those completing few cases. Working more than 35 hours at the point NRFU training began (variable 10) is in third place, and being retired (variable 20) is in fourth place. Performing the enumeration in an area where 75 percent or more of the dwellings are single family homes or farms (variable 29) is in fifth place. Having the original LCO manager leave before the start of the NRFU is in sixth place.

Unfortunately, we could not find a good way to rank the difference in means of the continuous variables, but suspect that many of those variables with strong explanatory power do so because they have large differences in means. This seems to hold for cases completed by other crew members (variable 71), population per square mile (variable 39), and the recruiting target (variable 41).

Knowledge of which variables have especially large coefficients tells us what the magnitude of the change would be if it were possible to alter the characteristics of the enumerators (for personal characteristics), and the per-enumerator magnitude of the difference for other variables. As before, 0/1 variables with especially large differences are indicated by bolding and shading. For example, employment status variables are in sixth, seventh, thirteenth, and twentieth position. This means that had the Census Bureau used employment status as a selection criteria, it could have produced exceptionally large differences in the number of cases completed per enumerator (holding other factors equal).

However, the variables with the largest coefficients are the 16 LCO dummies. This group includes the top 5 and 8 of the remaining top 20 0/1 variables. (Nine other LCOs were not included in this regression because an initial examination showed insignificant coefficients for these LCOs.) However, these exceptionally large coefficients are partially the result of strong interactions with LCO area variables. Nevertheless, we conclude that these large coefficients are indicative of the great importance of

cross-LCO variation. While we cannot pinpoint the source of these differences, we suspect much of it is due to variation in the way management implemented its instructions as well as the quality of management.

7.7.2 Individual Variables' Effect on Hours

Table 7-27 uses the same format as Table 7-26 to describe the effect of each explanatory variable on hours, as well as to decompose the effect based on differences in means and differences in the size of the regression coefficients. The dummy variable for the Minneapolis South LCO (variable 56) is in first place, while three other LCO dummies are in the top 20. Two demographic variables are in second and fourth place. The recruiting target and population density (variables 39 and 40) are in third and sixth place, with prevailing pay in twelfth place. Crew performance variables are in seventh, ninth, and eleventh place. As noted earlier, we regard the importance of LCO dummies, LCO characteristics, and crew performance as indicators that factors potentially under the control of census management made it possible to meet performance goals independent of any obstacles due to area or enumerator characteristics.

In terms of differences in means that distinguish characteristics associated with working above average versus below average hours on the NRFU, working full-time at the point enumerators were trained is in first place, (and the overall explanatory power of that variable is in sixth place). Being retired is in fourth place, and three other employment status variables are in the top 20. Demographic characteristics are in second, third, and seventh place.

Finally, differences in the size of the coefficients are largest among LCO dummies, and next largest among employment status variables, (as we found in examining cases in Table 7-26). The only other subgroup with large 0/1 variable coefficients is the demographic category.

7.7.3 Individual Variables' Effect on Cases per Hour

Table 7-28 uses the same format as Tables 7-26 and 7-27. In terms of having high explanatory power, population density (variable 39) is in first place, cases completed by other crew

Table 7-27. The effect of various variables on hours completed basis on using specification 1 and the mean difference between above average and below average enumerators

			Change in hours (difference in means x coefficient)		Means							
		Variable type	(B1-B2) X C1	Rank of change	Above average	Below average	Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
		(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
P1. Test Scores												
1	< 75	0/1	0.109	29	0.063	0.033	0.030	13	90.6%	3.68	37	0.512
2	75-79	0/1	-0.005	54	0.075	0.068	0.007	-40	10.4%	-0.71	-53	0.889
3	80-84	0/1	-0.013	56	0.113	0.103	0.010	-34	10.0%	-1.26	-49	0.785
4	85-89	0/1	0.230	18	0.179	0.138	**0.040**	**9**	29.1%	5.71	25	0.187
5	90-91	0/1	0.016	41	0.077	0.073	0.004	49	5.1%	4.23	34	0.385
6	92-93	0/1	-0.004	53	0.173	0.180	-0.007	-41	-3.9%	0.58	-55	0.891
7	94-95	0/1	-0.068	65	0.102	0.119	-0.017	-24	-14.4%	3.93	-35	0.377
8	96-97	0/1	-0.056	64	0.099	0.119	-0.020	-21	-17.0%	2.76	-41	0.534
9	98-100	0/1	-0.032	61	0.073	0.099	-0.025	-17	-25.6%	1.26	-50	0.786
	(score 101+ omitted)		0.178	49				28				
P2. Employment Status												
10	Worked +35 hr last week	0/1	**0.924**	**6**	0.158	0.278	**-0.120**	**1**	-43.2%	-7.69	19	0.037
11	Worked +35 hr 2-12 weeks ago	0/1	-0.001	49	0.050	0.052	-0.002	-55	-4.0%	0.62	-54	0.903
12	Worked +35 hr 13+ weeks ago	0/1	0.174	21	0.047	0.027	0.021	20	78.2%	8.35	18	0.120
13	Worked <35 hr last week	0/1	-0.003	51	0.085	0.100	-0.015	-27	-15.2%	0.22	-58	0.957
14	Worked <35 hr 2-12 weeks ago	0/1	0.047	37	0.040	0.031	0.008	37	26.2%	5.65	27	0.303
15	Worked <35 hr 13+ weeks ago	0/1	0.159	24	0.027	0.013	0.015	28	118.5%	10.67	14	0.112
16	Self-empl. in last 12 weeks	0/1	0.102	30	0.066	0.049	0.017	23	35.8%	5.81	24	0.218
17	Self-empl. 13+ weeks ago	0/1	0.005	46	0.013	0.010	0.003	50	32.6%	1.62	47	0.850
18	Looking for work within 12 weeks	0/1	-0.009	55	0.037	0.033	0.005	-46	13.9%	-1.97	-43	0.718
19	Looking for work13+ weeks ago	0/1	0.324	16	0.058	0.036			62.8%			
20	Retired	0/1	0.372	13	0.163	0.113			45.2%	7.32	21	0.070
21	Not working or looking	0/1	-0.004	52	0.027	0.028	0.000	-57	-1.7%	7.52	-20	0.201
22	Caregiver in last 12 weeks	0/1	0.012	42	0.026	0.024	0.002	54	9.2%	5.67	26	0.372
23	Caregiver 13+ weeks ago	0/1	**0.701**	**10**	0.060	0.032	0.028	14	87.6%	**24.89**	**7**	<.0001

Table 7-27. The effect of various variables on hours completed basis on using specification 1 and the mean difference between above average and below average enumerators (continued)

		Variable type	Change in hours (difference in means x coefficient) (B1-B2) X C1	Rank of change	Means: Above average	Means: Below average	Means: Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
		(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
24	Student	0/1	0.009	43	0.049	0.080	-0.031	11	-38.7%	-0.30	57	0.950
	(employment status unknown omitted)		2.812	33.0				29.7			0	
P3. Hourly Pay, Prior Job												
25	Hourly pay, worked last week	cont.	0.347	14	3.820	5.843	-2.023		-34.6%	-0.17		0.177
26	Hourly pay, worked 2-12 wks ago	cont.	0.083	31	2.083	1.579	0.504		31.9%	0.17		0.349
27	Hourly pay, worked 13+wks ago	cont.	0.033	40	5.309	3.972	1.337		33.7%	0.02		0.813
			0.463	28.3			-0.182			0.018		
C1. Crew Area												
28	Farms > 25%	0/1	-0.003	50	0.115	0.113	0.002	-56	1.8%	-1.59	-48	0.787
29	Single family homes + farms > 75%	0/1	0.004	47	0.473	0.476	-0.003	51	-0.5%	-1.72	45	0.738
30	Apartments > 50%	0/1	-0.017	58	0.100	0.095	0.005	-45	5.2%	-3.37	-38	0.575
31	Housing—none of the above	0/1	0.136	26	0.155	0.182	-0.027	15	-15.0%	-4.96	30	0.371
32	Low income > 50%	0/1	0.124	28	0.406	0.365	**0.041**	**8**	11.1%	3.05	40	0.549
33	High income > 50%	0/1	0.227	19	0.160	0.207	**-0.047**	**5**	-22.9%	-4.79	32	0.371
34	Moderate income >50, high>25	0/1	0.004	48	0.114	0.118	-0.004	47	-3.7%	-0.85	51	0.878
35	Moderate income >50, low>25	0/1	-0.081	66	0.076	0.101	-0.026	-16	-25.4%	3.13	-39	0.588
36	Income—none of the above	0/1	0.058	36	0.076	0.069	0.006	43	9.2%	9.00	17	0.129
37	Original crew leader stayed	0/1	0.034	39	0.590	0.609	-0.019	22	-3.1%	-1.81	44	0.379
	(crew area unknown omitted)		0.486	41.7			-0.072	30.8		-3.922	38	
L1. LCO Area												
38	Prevailing pay	cont.	0.390	12	16.24	16.42	-0.18		-1.1%	-2.18		0.039
39	Pop. per square mile	cont.	**0.976**	**5**	980.3	930.9	49.4		5.3%	0.02		0.001
40	Census pay rate	cont.	0.214	20	12.66	12.73	-0.06		-0.5%	-3.29		0.003
41	Recruiting target	cont.	**1.320**	**3**	4428.2	4571.4	-143.2		-3.1%	-0.01		0.055
42	Applications in Feb as % of target	cont.	-0.809	73	1.089	1.064	0.026		2.4%	-31.53		0.051
43	Original LCOM left	0/1	-0.349	71	0.069	0.103	**-0.035**	**-10**	-33.6%	10.06	-16	0.104
			1.741	30.7			-94.021			-26.936		

Table 7-27. The effect of various variables on hours completed basis on using specification 1 and the mean difference between above average and below average enumerators (continued)

		Variable type	Change in hours (difference in means x coefficient) (B1-B2) X C1	Rank of change	Means: Above average	Means: Below average	Means: Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
		(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
C2. Commuting												
44	Worked in area like own, but not own	0/1	0.046	38	0.339	0.348	-0.009	36	-2.6%	-5.11	29	0.165
45	Worked in area unlike own	0/1	-0.015	57	0.211	0.205	0.006	-44	2.9%	-2.52	-42	0.576
46	Commuting time, worked in own area	cont.	0.152	25	5.182	4.588	0.594		12.9%	0.26		0.142
47	Commuting time, worked in like area	cont.	0.170	22	5.931	5.364	0.566		10.6%	0.30		0.048
48	Commuting time, worked in unlike area	cont.	0.133	27	4.492	3.933	0.559		14.2%	0.24		0.156
			0.486	33.8			1.716			-6.834		
L3. LCO dummies												
49	New York NE	0/1	-0.132	67	0.012	0.016	-0.004	-48	-24.0%	**34.24**	**-5**	0.022
50	New York NW	0/1	**0.774**	**8**	0.015	0.006	0.008	38	130.6%	**94.23**	**1**	0.001
51	Queens NE	0/1	-0.188	68	0.026	0.024	0.002	-53	9.2%	**-85.85**	**-2**	0.006
52	Midland MI	0/1	-0.038	62	0.061	0.071	-0.010	-35	-14.3%	3.72	-36	0.681
53	Clarksville IN	0/1	0.077	33	0.047	0.034	0.013	30	38.8%	5.91	23	0.339
54	LaCrosse WI	0/1	0.250	17	0.024	0.036	-0.012	31	-32.8%	**-20.95**	**8**	0.003
55	Minneapolis	0/1	**1.976**	**1**	0.010	0.055	**-0.045**	**6**	-81.8%	**-44.32**	**4**	<.0001
56	St. Paul MN	0/1	0.346	15	0.002	0.009	-0.007	42	-74.8%	**-50.91**	**3**	0.004
57	Concord CA	0/1	-0.255	69	0.038	0.046	-0.008	-39	-17.2%	**32.03**	**-6**	0.066
58	Rock Hill SC	0/1	-0.053	63	0.018	0.029	-0.012	-32	-40.2%	4.48	-33	0.663
59	Gadsden AL	0/1	0.169	23	0.052	0.022	0.030	12	139.6%	5.59	28	0.377
60	Laredo TX	0/1	-0.261	70	0.041	0.055	-0.013	-29	-24.4%	**19.61**	**-9**	0.340
61	Phoenix North	0/1	0.007	45	0.079	0.079	0.000	58	0.5%	**15.97**	**10**	0.266
62	Scottsdale AZ	0/1	-0.029	60	0.072	0.074	-0.002	-52	-3.1%	12.60	-12	0.263
63	LA Downtown	0/1	-0.025	59	0.049	0.034	0.015	-26	45.6%	-1.63	-46	0.816
64	Woodland Hills CA	0/1	0.007	44	0.053	0.031	0.022	19	71.3%	0.31	56	0.957
			2.624	44.0			-0.021	34.4		25.028	18	
P4. Demographics												
65	dem1 (g)	0/1	0.076	34	0.611	0.626	-0.015	25	-2.5%	-4.90	31	0.011
66	dem2 (y)	0/1	**1.116**	**4**	0.124	0.234	**-0.110**	**2**	-46.8%	-10.18	15	0.004
67	dem3 (o)	0/1	0.064	35	0.318	0.233	**0.085**	**3**	36.5%	0.76	52	0.840
68	dem4 (z)	0/1	0.081	32	0.938	0.950	-0.012	33	-1.2%	-7.00	22	0.084
69	dem5 (p)	0/1	-0.493	72	0.243	0.201	**0.041**	**-7**	20.6%	-11.89	-13	0.000

Table 7-27. The effect of various variables on hours completed basis on using specification 1 and the mean difference between above average and below average enumerators (continued)

		Variable type	Change in hours (difference in means x coefficient) (B1-B2) X C1	Rank of change	Means: Above average	Means: Below average	Means: Difference	Means: Rank of dif.	Means: % Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
		(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
70	dem6 (a)	cont.	**1.719**	**2**	45.9	41.2	4.7		11.5%	0.36		0.006
			2.562	29.8			4.718			-32.84	27	
C3. Crew Performance												
71	Cases by wk5 other crew members	cont.	0.486	11	1027.3	996.8	30.5		3.1%	0.02		<.0001
72	Maximum number of crew members	cont.	**0.765**	**9**	9.105	9.412	-0.306		-3.3%	-2.50		<.0001
73	%cases others completed by wk5	cont.	**0.881**	**7**	0.848	0.823	0.025		3.0%	35.44		0.005
			2.132	9.0			30.169			32.96		
	Estimated differences in cases		13.484	N	1310	1431			mean hours	98.886		
	Actual difference in cases		77.016	Hours	139.148	62.133			adj. R-sq	0.1520		
	Percent explained		17.5%									

Notes: Ranking based on absolute value of relevant variable. Negative signs indicate effect of variable reduces difference between above and below average enumerators

Ranking on means and coefficients only provided for 0/1 variables. The differences in the units of continuous variables makes rankings unmeaningful.

Shading in column 1 indicates continuous variables; shading in columns A1-A2 indicates top 20 variables with respect to effect on cases, bolding indicates top

Shading in columns B3-B4 indicates top 20 with respect to differences in 0/1 variable means for above/below average enumerators, bolding indicates top 10.

Shading in columns C1-C2 indicates top 20 with respect to differences in coefficients (for 0/1 variables only), bold indicates top 10.

Shading in column C3 indicates coefficient (in col C1) is statistically different from 0 at least at the 5 percent level.

27 LCOs are included in this study. Because of the strong interaction between LCO dummies and LCO area we omitted dummies for:

Stamford CT, Flint MI, Saginaw MI, Cincinnati OH, Rochester MN, Oakland CA, San Francisco-NE, Covington KY, Charlotte NC, Monroe NC, Birmingham AL,

Newnan GA, Phoenix-S, and Pasadena CA. These LCOs were selected to be omitted because they had the smallest regression coefficients.

Table 7-28. The effect of various variables on case per hour completed basis on using specification 1a and the mean difference between above average and below average enumerators

				Means							
	Variable type	Change in cases per hour (difference in means x coefficient) (B1-B2)X C1	Rank of change	Above average	Below average	Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
	(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
P1. Test Scores											
1 < 75	0/1	0.0026	24	0.035	0.056	-0.021	25	-37.0%	-0.1244	16	0.0206
2 75-79	0/1	**0.0087**	**7**	0.045	0.091	**-0.0469**	**4**	-51.3%	**-0.1848**	**6**	0.0001
3 80-84	0/1	0.0025	25	0.096	0.117	-0.021	24	-17.8%	-0.1216	18	0.0060
4 85-89	0/1	0.0031	21	0.138	0.173	-0.035	13	-20.1%	-0.0895	24	0.0307
5 90-91	0/1	-0.0002	-62	0.087	0.066	0.020	-26	30.5%	-0.0098	-57	0.8339
6 92-93	0/1	-0.0013	-36	0.185	0.171	0.014	-32	8.4%	-0.0930	-23	0.0204
7 94-95	0/1	-0.0011	-41	0.120	0.104	0.016	-30	15.2%	-0.0664	-29	0.1183
8 96-97	0/1	-0.0010	-42	0.123	0.100	0.023	-20	23.0%	-0.0457	-34	0.2822
9 98-100	0/1	-0.0007	-48	0.103	0.074	0.029	-18	38.5%	-0.0258	-46	0.5619
(score 101+ omitted)		0.0125	34.0			-0.0213	21		-0.7610	28.1	
P2. Employment Status											
10 Worked +35 hr last week	0/1	0.0017	33	0.247	0.200	**0.047**	**5**	23.4%	0.0359	40	0.3093
11 Worked +35 hr 2-12 weeks ago	0/1	0.0002	63	0.048	0.053	-0.005	43	-9.3%	-0.0394	38	0.4188
12 Worked +35 hr 13+ weeks ago	0/1	-0.0002	-65	0.034	0.038	-0.004	-49	-9.3%	0.0533	-32	0.2996
13 Worked <35 hr last week	0/1	0.0000	75	0.093	0.092	0.001	54	1.3%	0.0341	41	0.3888
14 Worked <35 hr 2-12 weeks ago	0/1	0.0005	53	0.030	0.039	-0.009	36	-23.0%	-0.0593	30	0.2589
15 Worked <35 hr 13+ weeks ago	0/1	0.0011	40	0.024	0.016	0.008	39	51.4%	0.1325	14	0.0391
16 Self-empl. in last 12 weeks	0/1	0.0001	70	0.059	0.056	0.003	51	5.0%	0.0262	45	0.5611
17 Self-empl. 13+ weeks ago	0/1	0.0005	55	0.013	0.010	0.004	48	39.2%	0.1234	17	0.1332
18 Looking for work within 12 weeks	0/1	0.0002	60	0.030	0.039	-0.008	38	-21.7%	-0.0286	44	0.5838
19 Looking for work 13+ weeks ago	0/1	0.0007	49	0.032	0.057	-0.025	19	-44.3%	-0.0287	43	0.5431
20 Retired	0/1	0.0003	58	0.143	0.132	0.011	35	8.2%	0.0257	47	0.5055
21 Not working or looking	0/1	0.0006	52	0.032	0.024	0.007	41	30.5%	0.0761	26	0.1761

Table 7-28. The effect of various variables on case per hour completed basis on using specification 1a and the mean difference between above average and below average enumerators (continued)

				Means							
	Variable type	Change in cases per hour (difference in means x coefficient) (B1-B2)X C1	Rank of change	Above average	Below average	Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
	(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
22 Caregiver in last 12 weeks	0/1	0.0001	72	0.025	0.024	0.001	55	3.0%	0.0945	22	0.1196
23 Caregiver 13+ weeks ago	0/1	0.0000	-74	0.044	0.047	-0.003	-50	-7.0%	0.0129	-55	0.7895
24 Student	0/1	-0.0002	-67	0.061	0.068	-0.008	-40	-11.3%	0.0214	-50	0.6359
(employment status unknown omitted)		0.0056	59.1			0.0198	40.2		0.4800	36.3	
P3. Hourly Pay, Prior Job											
25 Hourly pay, worked last week	cont.	0.0010	43	5.490	4.406	1.084		24.6%	0.00090		0.4608
26 Hourly pay, worked 2-12 wks ago	cont.	0.0000	-73	1.803	1.833	-0.030		-1.7%	0.0016		0.3560
27 Hourly pay, worked 13+wks ago	cont.	0.0000	78	4.624	4.601	0.022		0.5%	0.000031		0.9747
		0.0009	64.7			1.0761			0.0025		
C1. Crew Area											
28 Farms > 25%	0/1	0.0022	29	0.104	0.120	-0.016	28	-13.4%	-0.1338	12	0.0179
29 Single family homes + farms > 75%	0/1	-0.0012	-38	0.504	0.452	**0.0515**	**-3**	11.4%	-0.0240	-49	0.6267
30 Apartments > 50%	0/1	-0.0005	-54	0.076	0.114	-0.038	-11	-33.6%	0.0135	-54	0.8140
31 Housing—none of the above	0/1	0.0001	69	0.187	0.156	0.031	17	19.7%	0.0045	58	0.9319
32 Low income > 50%	0/1	-0.0017	-34	0.359	0.405	**-0.0455**	**-6**	-11.2%	0.0368	-39	0.4502
33 High income > 50%	0/1	0.0000	-77	0.184	0.184	0.000	-57	0.0%	0.0173	-52	0.7363
34 Moderate income >50, high>25	0/1	0.0050	15	0.149	0.091	**0.0580**	**2**	63.9%	0.0868	25	0.1010
35 Moderate income >50, low>25	0/1	0.0014	35	0.101	0.080	0.021	23	26.3%	0.0672	28	0.2244
36 Income—none of the above	0/1	0.0001	71	0.075	0.070	0.005	45	6.6%	0.0153	53	0.7876
37 Original crew leader stayed	0/1	0.0017	32	0.624	0.581	**0.0429**		7.4%	0.0405	36	0.0397
(crew area unknown omitted)		0.0071	45.4			0.1086	20.0		0.1240	40.6	

Table 7-28. The effect of various variables on case per hour completed basis on using specification 1a and the mean difference between above average and below average enumerators (continued)

				Means							
	Variable type	Change in cases per hour (difference in means x coefficient) (B1-B2)X C1	Rank of change	Above average	Below average	Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
	(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
L1. LCO Area											
38 Prevailing pay	cont.	**0.0066**	**10**	15.65	16.85	-1.204		-7.1%	-0.0055		0.5876
39 Pop. per square mile	cont.	**0.0462**	**1**	664.6	1176.6	-512.0		-43.5%	-0.0001		0.1078
40 Census pay rate	cont.	**-0.0132**	**-3**	12.31	12.99	-0.677		-5.2%	0.0195		0.0624
41 Recruiting target	cont.	0.0002	66	4413.5	4571.5	-158.0		-3.5%	0.0000		0.9812
42 Applications in Feb as % of target	cont.	-0.0036	-18	1.107	1.052	0.055		5.2%	-0.0658		0.6705
43 Original LCOM left	0/1	0.0055	13	0.064	0.104	**-0.0405**	**9**	-38.8%	-0.1371	11	0.0209
		0.0417	18.5			-671.8			-0.1890		
C2. Commuting											
44 Worked in area like own, but not own	0/1	0.0009	44	0.362	0.330	0.032	16	9.6%	0.0296	42	0.4007
45 Worked in area unlike own	0/1	0.0002	64	0.210	0.206	0.005	44	2.3%	0.0405	35	0.3472
46 Commuting time, worked in own area	cont.	0.0037	17	4.148	5.427	-1.279		-23.6%	-0.0029		0.0864
47 Commuting time, worked in like area	cont.	0.0003	59	5.602	5.660	-0.058		-1.0%	-0.0047		0.0012
48 Commuting time, worked in unlike area	cont.	0.0031	20	3.874	4.450	-0.576		-12.9%	-0.0055		0.0007
		0.0082	40.8			-1.8762			0.0572		
L3. LCO Dummies											
49 New York NE	0/1	0.0012	39	0.008	0.019	-0.012	34	-60.8%	-0.1000	20	0.4838
50 New York NW	0/1	0.0025	26	0.002	0.017	-0.015	31	-90.0%	**-0.1634**	**7**	0.5287
51 Queens NE	0/1			0.007	0.039			-82.6%	**0.3276**	**-2**	0.2685
52 Midland MI	0/1			0.091	0.048			90.5%	**0.2095**	**5**	
53 Clarksville IN	0/1	0.0028	22	0.052	0.030	0.022	22	72.2%	0.1272	15	
54 La Crosse WI	0/1	0.0009	45	0.024	0.036	-0.013	33	-34.7%	-0.0732	27	0.2847
55 Minneapolis	0/1	-0.0007	-51	0.032	0.034	-0.002	-53	-6.4%	**0.2970**	**-3**	0.0006
56 St. Paul MN	0/1	0.0020	30	0.008	0.004	0.005	47	117.5%	**0.4463**	**1**	0.0077
57 Concord CA	0/1	-0.0002	-68	0.039	0.045	-0.006	-42	-14.2%	0.0255	-48	0.8784

Table 7-28. The effect of various variables on case per hour completed basis on using specification 1a and the mean difference between above average and below average enumerators (continued)

				Means							
	Variable type	Change in cases per hour (difference in means x coefficient) (B1-B2)X C1	Rank of change	Above average	Below average	Difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
	(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
58 Rock Hill SC	0/1	0.0023	27	0.033	0.017	0.016	29	95.8%	**0.1433**	**9**	0.1449
59 Gadsden AL	0/1	**0.0114**	**4**	0.059	0.019	**0.040**	**10**	215.1%	**0.2848**	**4**	<.0001
60 Laredo TX	0/1	0.0004	56	0.050	0.047	0.003	52	5.5%	**0.1405**	**10**	0.4753
61 Phoenix North	0/1	0.0055	14	0.100	0.063	0.037	12	58.5%	**0.1498**	**8**	0.2761
62 Scottsdale AZ	0/1	0.0066	11	0.108	0.046	**0.063**	**1**	137.2%	0.1048	19	0.3318
63 LA Downtown	0/1	0.0064	12	0.013	0.062	-0.048	58	-78.2%	-0.1332	13	0.0476
64 Woodland Hills CA	0/1	0.0009	47	0.046	0.037	0.009	37	23.8%	0.0999	21	0.0696
		0.0407	28.9				30.2			13.3	
P4. Demographics											
65 dem1 (g)	0/1	0.000005	76	0.619	0.619	0.000	56	0.1%	0.0122	56	0.5069
66 dem2 (y)	0/1	0.00176	31	0.163	0.196	-0.033	14	-16.7%	-0.0537	31	0.1105
67 dem3 (o)	0/1	0.00024	61	0.276	0.271	0.005	46	1.7%	0.0512	33	0.1535
68 dem4 (z)	0/1	-0.00092	-46	0.957	0.934	0.023	-21	2.4%	-0.0402	-37	0.2996
69 dem5 (p)	0/1	-0.00032	-57	0.231	0.213	0.018	-27	8.4%	-0.0177	-51	0.5756
70 dem6 (a)	cont.	-0.00072	-50	43.834	43.212	0.622		1.4%	-0.0012		0.3556
		0.000041	321			0.635	33		-0.0493	41.6	
C3. Crew Performance											
71 Cases by wk 5 other crew members	cont.	**0.0407**	**2**	1120.0	928.1	191.9		20.7%	0.0002		<.0001
72 Maximum number of crew members	cont.	**-0.0070**	**-9**	9.410	9.155	0.255		2.8%	-0.0274		<.0001
73 %cases others completed by wk 5	cont.	**0.0072**	**8**	0.844	0.829	0.015		1.8%	0.4752		<.0001
		0.0410	19			192.1			0.4480		

Table 7-28. The effect of various variables on case per hour completed basis on using specification 1a and the mean difference between above average and below average enumerators (continued)

				Means							
	Variable type	Change in cases per hour (difference in means x coefficient) (B1-B2)X C1	Rank of change	Above average	Below average	difference	Rank of dif.	% Difference relative to mean	Regression coefficient	Rank of coef	Level of confidence
	(1)	A1	A2	B1	B2	B3	B4	B5	C1	C2	C3
Hours											
74 Hours, given hours < 30	cont.	0.0023	28	1.45	1.06	0.388		36.7%	0.0059		0.0227
75 Hours, given hours 30-59	cont.	0.0013	37	8.21	7.47	0.745		10.0%	0.0017		0.1069
76 Hours, given hours 60-89	cont.	0.0040	16	17.98	15.15	2.833		18.7%	0.0014		0.0351
77 Hours, given hours 90-120	cont.	0.0035	19	25.84	22.17	3.662		16.5%	0.0009		0.0495
78 Hours, given hours > 120	cont.	0.0027	23	41.47	56.16	-14.694		-26.2%	-0.0002		0.5564
		0.0137	24.6			-7.065			0.0098		
Estimated differences in cases		0.171		1189	1552			mean cases	1.089		
Actual difference in cases		0.747		1.511	0.764			adj. R-sq	0.1920		
Percent Explained		23.0%									

Notes:

Ranking based on absolute value of relevant variable. Negative signs indicate effect of variable reduces difference between above and below average enumerators.

Ranking on means and coefficients only provided for 0/1 variables. The differences in the units of continuous variables makes rankings unmeaningful.

Shading in column 1 indicates continuous variables; shading in columns A1-A2 indicates top 20 variables with respect to effect on cases, bolding indicates top 10.

Shading in columns B3-B4 indicates top 20 with respect to differences in 0/1 variable means for above/below average enumerators, bolding indicates top 10.

Shading in columns C1-C2 indicates top 20 with respect to differences in coefficients (for 0/1 variables only), bold indicates top 10.

Shading in column C3 indicates coefficient (in col C1) is statistically different from 0 at least at the 5 percent level.

27 LCOs are included in this study. Because of the strong interaction between LCO dummies and LCO area, we omitted dummies for:

Stamford CT, Flint MI, Saginaw MI, Cincinnati OH, Rochester MN, Oakland CA, San Francisco-NE, Covington KY, Charlotte NC, Monroe NC, Birmingham AL, Newnan GA, Phoenix-S, and Pasadena CA. These LCOs were selected to be omitted because they had the smallest regression coefficients.

members (variable 71) is in second place, and census pay (variable 40) is in third place (but its effect is in the "wrong" direction of narrowing the difference in cases per hour). In Table 7-28 several variables with high explanatory power have effects in the wrong direction because there are strong interactions among variables in the LCO area, crew performance, and LCO dummy subgroups. Thus, we believe that more weight should be given to the net effect of each subgroup than to specific variables.

In terms of having large differences in means, the Scottsdale LCO is in first place, and four other LCO dummies are in the top 20. Working in areas where most residents have medium to high incomes (variable 34) is in second place, and residents living in single family homes or farms (variable 29) is in third place. Also in the crew area category, having few residents having low incomes (variable 32) is in sixth place, and working for the original crew leader (variable 37) is in eighth place.

Importantly, having few enumerators with test scores between 75 and 79 (variable 2) is in fourth place, and having many with tests scores between 94 and 97 (variables 8 and 9) are in eighteenth and twentieth places. There simply is no question that having low test scores is strongly associated with low productivity per hour worked, and vice versa. However, it also is notable that low test scores are associated with working long hours. (See Section P1 of Table 7-27.) Thus, in terms of completing the work quickly, low hourly performance is offset by high hours worked.

More generally, there is a lot of overlap among the variables with large differences in means associated with completing many cases (shown in column B of Table 7-26) and those associated with working many hours (shown in column B3 of Table 7-27) In contrast, there is little overlap between those variables and variables associated with above average cases per hour. This is further evidence that each enumerator working many hours was the key to completing many cases, and quickly completing the NRFU. Also, enumerators completing many cases per hour tended to work below the average number of hours.

As with cases and hours, LCO dummies had the largest coefficients when cases per hour was used as the dependent variable. The next largest group of top 20 variables were those associated with low test scores, which had coefficients in sixth, sixteenth, and eighteenth place. Other variables with large coefficients include working in a predominately farming area (variable 28), and working in an LCO where the original manager left (variable 43).

7.7.4 Summary

Examining the three tables in this section provides additional information about which subgroups and which individual variables have high explanatory power. Perhaps even more importantly, the tables provide a great deal of information about what characteristics were associated with above average and below average cases, hours, and cases per hour.

One key result is that similar characteristics are associated with above-average cases and hours, but different characteristics are associated with above-average cases per hour. Thus, it is clear that hiring enumerators able and willing to work many hours over at least 4 weeks was the primary determinant of completing many cases, and thereby, speedily completing the NRFU as a whole.

Hiring workers able to complete many cases per hour may have had a small effect on the total number of cases completed per enumerator and the overall speed of completing the NRFU, but it appears that most enumerators able to complete many cases per hour did not work many hours. Precisely why this was the case is unclear.

A second important value of the tables in this section is describing which variables had large regression coefficients. While differences in actual characteristics of enumerators with above-average and below-average performance tells us a lot about the source of observed differences, knowledge of the size of the individual coefficients tells us how large would be the effect of altering the actual distribution of characteristics. The most direct application of this information is in estimating the benefits and costs of altering the criteria used to select enumerators. These results suggest that gains in speed and reductions in cost would stem from using minimum test scores to eliminate hiring enumerators who would not be very productive, and instead, by placing more emphasis on screening out candidates with impediments to working long hours, such as being employed at full-time jobs. This could be accomplished by using the "availability" question in the application to set the order for offering census jobs to applicants. We believe that the use of additional screens is especially warranted now that it is evident that more competitive wages attracted candidates with far higher average test scores than were able to be attracted in 1990.

Finally, we believe that the very strong explanatory power associated with LCO dummies, crew performance, and LCO characteristics over which the Census Bureau had at least some control, suggests that the ability of regional and local managers to execute the basic plan developed by headquarters was the primary determinant of variation in performance. More specifically, the observed

variation in the degree or frontloading had far greater effects on cases completed than the negative influence of factors that were outside the control of the Census Bureau.

8. SUMMARY AND CONCLUSIONS

This report consists of three distinct, but related, analyses:

- The first compares the performance of the 1990 and 2000 Non-Response Follow-Ups (NRFUs) using published reports plus tabulations we developed from administrative data covering two-thirds of the 1990 local census offices (LCOs) and all but one of the 2000 LCOs.

- The second compares the performance across 510 LCOs during the 2000 NRFU based on regressions and tabulations using several administrative databases we developed together with published statistics describing area characteristics.

- The third compares the performance across 2,751 enumerators who worked in 376 crews in 27 LCOs based on regressions and tabulations using a combination of three administrative databases we developed and five surveys we executed.

Our comparison of the 1990 and 2000 NRFUs demonstrates that in 2000 the bulk of the enumeration was completed within 6 weeks, and the entire field operation was completed within about 9 weeks, in keeping with the Census Bureau's plan. In contrast, the 1990 NRFU was completed far more slowly than the 9 weeks allotted and required major pay increases.

Overall, an average 2000 LCO completed its NRFU work in 7.19 weeks, compared to 9.72 weeks in 1990. Moreover, the worst performing LCOs in 2000 completed the NRFU as fast as the best performing LCOs in 1990.

To achieve these improvements in performance, the Census Bureau introduced frontloading (increasing the number of enumerators at work initially relative to cases to complete) so there would be twice the number of enumerators needed, if there were no attrition, and increased pay by 37.8 percent in an average LCO (adjusted for inflation). Our evidence suggests that increasing pay was a key factor in increasing weekly retention, which was only .738 during the 1990 NRFU, to .905, which is close to its natural limit. Higher pay increased incentives for enumerators to remain until they were no longer needed, but perhaps more importantly, was instrumental in securing enough applicants to meet the frontloading goals, while also dramatically increasing the competence of the applicants (as measured by their test scores and pay levels at non-census jobs).

Our comparison of 2000 performance across 519 LCOs shows that, while the vast majority of LCOs met their completion goals, some LCOs completed their work considerably faster than others. The fastest 81 LCOs completed 95 percent of their work in 5.49 weeks, while the slowest 79 LCOs took

7.55 weeks to reach the same point. Most of the differences in completion time were directly related to differences in the degree of frontloading and the overall speed with which enumerators began work.

More specifically, the fastest LCOs had one enumerator at work the first week for each 136 cases to complete and substantially exceeded minimum frontloading targets. In contrast, the slowest LCOs had only one enumerator at work in the first week for each 277 cases to complete and did not reach their targets until the end of the second week. On average, it took only 2.56 weeks for 90 percent of all enumerators who ever worked in one of the fastest LCOs to begin work, but 4.75 weeks for the slowest LCOs to reach that point.

Our regression analysis of 510 LCOs with adequate data identified 17 factors that explained over 63 percent of the variation in the percent of cases completed by the end of the third full week of the NRFU, the period where performance differences were greatest. Roughly half of the explanatory power of this regression stemmed from variation in the degree of frontloading. With the frontloading variable removed, the remaining variables explained more than 40 percent of all the variation, which is exceptionally high for this type of analysis. However, several of those variables gained much of their power because they were correlated with the degree of frontloading.

In particular, our analysis suggests that actions by regional managers in setting frontloading targets and monitoring hiring performance explained much of the variation in the degree of frontloading and overall completion speed. Importantly, our analysis is highly consistent with census officials' observations about regional management differences, especially in explaining why the performance of the Los Angeles region showed marked improvement over 1990. At the local level, turnover of LCO managers (LCOMs) also had strong explanatory power, presumably because high quality local management was needed to meet or exceed frontloading goals and deal with a variety of other problems that could impede swift progress.

Also, LCOs with above average cases to complete finished their work more slowly. On average, the 79 slowest-completing LCOs had to complete close to 84,000 cases, compared to only 63,000 cases in the 81 fastest-completing LCOs. The magnitude of these differences suggests that it is much more difficult to manage the staff needed to handle large caseloads than small caseloads. However, the flexibility of Census Bureau officials to equalize workloads is limited because many offices cover such large geographic areas that it would not be feasible to further increase their size.

To make matters worse, the NRFU was completed more quickly in areas where local pay, applicant test scores, and population density all were below average. This evidence strongly suggests that it was inherently easier to complete the NRFU in rural areas and harder in large cities and affluent suburbs. Thus, it appears that the managers of offices with large caseloads had especially difficult assignments, and equalizing difficulty probably would require increasing the total number of offices and putting more offices in and near large cities.

Finally, our regression analysis of 510 LCOs showed that high enumerators' test scores were correlated with speedy completion of cases. However, this relationship held because high test scores reflected having a large applicant pool relative to the number of enumerators hired, not because enumerators with higher test scores were more productive. But even more importantly, differences in the size of the recruiting pool could not explain why slow-completing LCOs did not meet frontloading goals and continued to add enumerators while the NRFU was underway. (This is because all LCOs had at least 3.4 qualified applicants to fill each enumerator slot.)

Because we lacked data on the number, timing, and refusal rate of applicants asked to accept enumerator positions, and on the intentions of census managers, we were unable to definitively sort out the relative importance of three plausible explanations for why some LCO managers did not meet frontloading goals: (1) they had an inherently more difficult hiring task; (2) they did not effectively manage hiring operations; or (3) they did not feel it was essential to meet frontloading goals.

What we do know (from our recruiting study) is that the size and quality of the applicant pool was affected by the level of enumerator pay relative to local pay. From this study we have learned that slow-completing LCOs had below average ratios of census pay to local pay. On average, the census pay–local pay ratio was .764 in the slowest completing LCOs, compared to .824 in the fastest completing LCOs. Thus, it is possible that wage offers were low enough to adversely affect acceptance rates, (especially because offers were made in order of test scores and high test scores were correlated with holding high-wage, full-time jobs).

On the other hand, pay, test scores, and density, as well as other area characteristics included in our enumerator-level analysis had relatively small effects on cases completed. Instead, LCO dummies and LCO characteristics that were under the control of census management to some extent had much larger effects. While our analysis may have omitted important determinants of performance that were outside of the control of census managers, our evidence from this study and our recruiting study suggests

that differences in management characteristics played a much larger role in determining recruiting and enumeration outcomes than factors outside of the managers' control. Thus, we feel that differences in both recruiting and staffing patterns largely were due to differences in management characteristics.

Put another way, our study of the individual performance of 2,751 enumerators showed that (1) the difference in the number of cases available for completion by a given enumerator was the primary determinant of variation in the total number of cases completed by the end of the fourth week in a given LCO, and (2) the degree of frontloading was the primary determinant of the number of cases available to be completed by a given enumerator. While the finding that the more enumerators at work in a given LCO the less cases are completed by any single enumerator may appear to be so obvious that it is empty of meaning, this statement was not true in 1990. In that NRFU, the numbers of enumerators at work on any day during the first 5 weeks was so low (relative to the number of cases left to complete), each enumerator could act as if there were no limit to the number of cases he or she could complete.

Thus, our most fundamental conclusion from this study is that the Census Bureau's ability to recruit and hire large numbers of high quality applicants gave managers of most LCOs the ability to attain the level of frontloading needed to meet or exceed the 9-week completion targets. Further, it appears that pay was set sufficiently high that the applicant pools were large enough to have completed the entire NRFU in as few as 7 weeks, had that goal been set, in LCOs where hiring went smoothly.

We also found that the employment status of enumerators just prior to being hired strongly affected the number of cases they completed. Enumerators who were not working when hired, and not looking for work, retired, or family caregivers completed 30 to 40 more cases than enumerators who were employed full-time. Given that, on average, enumerators in our sample completed 105 cases, this represents about a 35 percent improvement in performance.

Coupling the above results with our finding that test scores above a threshold of about 82 did not have much of an effect on cases completed, led to our another key conclusion—that the Census Bureau could substantially improve completion time and modestly reduce cost by: (1) using test scores of about 82 to screen out applicants (unless they had special language or other skills), and (2) ordering hiring contact lists by hours of availability (from their applications), employment status, and other indicators of the number of hours enumerators were able to commit to census work.

Our analysis also showed that enumerators working in areas where local pay, population density, and workloads were low completed 10 to 15 more cases than enumerators working in areas where these factors were high. Further, we found that working in high-income neighborhoods, especially with large high-rise apartments, reduced the number of cases completed, but working in low income areas did not adversely affect performance.

That characteristics of the area in which an LCO operates, characteristics of the recruiting pool and enumerators hired, and characteristics of the LCO and regional management all have significant effects on cases completed leads to a third important conclusion—that it should be possible to develop an equation to better tailor frontloading goals to the specific characteristics of each LCO and the overall schedule set by headquarters.

We do not pretend to know what should be the optimal schedule. The problem here is that our analysis only examined completion speed, while it would be necessary to know the effect of speed on accuracy and cost to determine the optimal schedule.

Finally, all three analyses taken together clearly tell us that, in sharp contrast to 1990, enumerator pay was not set too low. Increasing pay to about 79 percent of local pay certainly dramatically improved the size of applicant pools, the quality of the applicants, and retention of enumerators—all of which made major contributions to the success of the 2000 NRFU. What we cannot say is whether had pay been set lower, the 2000 NRFU would have been equally successful. The reason for this ambiguity is that while it appears lowering pay would not have had much effect on retention, it would have adversely affected the quality of applicants and might have also adversely affected job offer acceptance rates.

Appendix A

Descriptive Statistics for Tables 7-26, 7-27 and 7-28

APPENDIX A

DESCRIPTIVE STATISTICS FOR TABLES 7-26, 7-27 AND 7-28

Variable	Mean	Standard deviation	Minimum	Maximum	Source
Cases completed	105.622	68.445	1.000	580.000	OCS
Hours completed	98.941	48.040	0.000	415.000	P/A
Cases per hour completed	1.088	0.471	0.250	3.532	OCS
P1. Test Scores					
< 75	0.047	0.212	0.000	1.000	Census
75-79	0.071	0.257	0.000	1.000	Census
80-84	0.108	0.310	0.000	1.000	Census
85-89	0.158	0.364	0.000	1.000	Census
90-91	0.075	0.264	0.000	1.000	Census
92-93	0.177	0.382	0.000	1.000	Census
94-95	0.111	0.315	0.000	1.000	Census
96-97	0.110	0.313	0.000	1.000	Census
98-100	0.086	0.281	0.000	1.000	Census
P2. Employment Status					
Worked +35 hr last week	0.221	0.415	0.000	1.000	Pre
Worked +35 hr 2-12 weeks ago	0.051	0.219	0.000	1.000	Pre
Worked +35 hr 13+ weeks ago	0.036	0.188	0.000	1.000	Pre
Worked <35 hr last week	0.093	0.290	0.000	1.000	Pre
Worked <35 hr 2-12 weeks ago	0.035	0.185	0.000	1.000	Pre
Worked <35 hr 13+ weeks ago	0.020	0.139	0.000	1.000	Pre
Self-empl. in last 12 weeks	0.057	0.232	0.000	1.000	Pre
Self-empl. 13+ weeks ago	0.011	0.106	0.000	1.000	Pre
Looking for work within 12 weeks	0.035	0.184	0.000	1.000	Pre
Looking for work13+ weeks ago	0.046	0.210	0.000	1.000	Pre
Retired	0.137	0.344	0.000	1.000	Pre
Not working or looking	0.028	0.164	0.000	1.000	Pre
Caregiver in last 12 weeks	0.025	0.156	0.000	1.000	Pre
Caregiver 13+ weeks ago	0.046	0.209	0.000	1.000	Pre
Student	0.065	0.246	0.000	1.000	Pre
P3. Hourly Pay, Prior Job					
Hourly pay, worked last week	4.876	8.737	0.000	173.150	Pre
Hourly pay, worked 2-12 wks ago	1.820	5.755	0.000	90.000	Pre
Hourly pay, worked 13+wks ago	4.611	10.078	0.000	150.000	Pre

Note: Key for source variable:

BLS = Bureau of Labor Statistics
Census = Census Bureau
CLQ = Crew Leader Questionnaire
Int = Interim Survey
Pre = Pre-NRFU Survey
P/A = PAMS/ADAMS
OCS = OCS 2000

APPENDIX A (continued)

DESCRIPTIVE STATISTICS FOR TABLES 7-26, 7-27 AND 7-28

Variable	Mean	Standard deviation	Minimum	Maximum	Source
C1. Crew Area					
Farms > 25%	0.113	0.317	0.000	1.000	CLQ
Single family homes + farms > 75%	0.475	0.499	0.000	1.000	CLQ
Apartments > 50%	0.097	0.297	0.000	1.000	CLQ
Housing – none of the above	0.169	0.375	0.000	1.000	CLQ
Low income > 50%	0.385	0.487	0.000	1.000	CLQ
High income > 50%	0.184	0.388	0.000	1.000	CLQ
Moderate income >50, high>25	0.116	0.320	0.000	1.000	CLQ
Moderate income >50, low>25	0.089	0.285	0.000	1.000	CLQ
Income – none of the above	0.072	0.259	0.000	1.000	CLQ
Original crew leader stayed	0.600	0.490	0.000	1.000	CLQ
L1. LCO Area					
Prevailing pay	16.330	4.269	9.469	33.957	BLS
Pop. per square mile	954.524	1377.530	8.000	7834.000	Census
Census pay rate	12.697	2.144	6.000	18.500	Census
Recruiting target	4502.990	1112.510	2180.000	7170.000	Census
Applications in Feb as % of target	1.076	0.495	0.341	2.665	Census
Original LCOM left	0.087	0.282	0.000	1.000	Census
C2. Commuting					
Worked in area like own, but not own	0.344	0.475	0.000	1.000	Int
Worked in area unlike own	0.208	0.406	0.000	1.000	Int
Commuting time, worked in own area	4.872	7.477	0.000	60.000	Int
Commuting time, worked in like area	5.635	9.712	0.000	70.000	Int
Commuting time, worked in unlike area	4.200	9.697	0.000	76.000	Int
L3. LCO Dummies					
New York NE	0.014	0.118	0.000	1.000	Census
New York NW	0.010	0.101	0.000	1.000	Census
Queens NE	0.025	0.156	0.000	1.000	Census
Midland MI	0.066	0.249	0.000	1.000	Census
Clarksville IN	0.040	0.195	0.000	1.000	Census
LaCrosse WI	0.031	0.172	0.000	1.000	Census
Minneapolis	0.033	0.179	0.000	1.000	Census
St. Paul MN	0.006	0.076	0.000	1.000	Census
Concord CA	0.042	0.201	0.000	1.000	Census
Rock Hill SC	0.024	0.152	0.000	1.000	Census

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APPENDIX A (continued)

DESCRIPTIVE STATISTICS FOR TABLES 7-26, 7-27 AND 7-28

Variable	Mean	Standard deviation	Minimum	Maximum	Source
L3. LCO Dummies (continued)					
Gadsden AL	0.036	0.187	0.000	1.000	Census
Laredo TX	0.048	0.214	0.000	1.000	Census
Phoenix North	0.079	0.270	0.000	1.000	Census
Scottsdale AZ	0.073	0.260	0.000	1.000	Census
LA Downtown	0.041	0.198	0.000	1.000	Census
Woodland Hills CA	0.041	0.199	0.000	1.000	Census
P4. Demographics					
dem1 (g)	0.619	0.486	0.000	1.000	Census
dem2 (y)	0.182	0.386	0.000	1.000	Census
dem3 (o)	0.273	0.446	0.000	1.000	Census
dem4 (z)	0.944	0.230	0.000	1.000	Census
dem5 (p)	0.221	0.415	0.000	1.000	Census
dem6 (a)	43.482	16.355	15.614	81.710	Census
C3. Crew Performance					
Cases by wk5 other crew members	1011.370	533.575	0.000	2953.000	OCS
Maximum number of crew members	9.265	3.382	1.000	20.000	OCS
%cases others completed by wk5	0.835	0.112	0.238	1.000	OCS
Hours					
Hours, given hours < 30	1.226	5.157	0.000	30.000	P/A
Hours, given hours 30-59	7.791	17.771	0.000	60.000	P/A
Hours, given hours 60-89	16.375	31.168	0.000	90.000	P/A
Hours, given hours 90-120	23.762	43.963	0.000	120.000	P/A
Hours, given hours > 120	49.786	74.021	0.000	415.000	P/A

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Appendix B

List of LCOs in Sample

APPENDIX B.

LIST OF 27 LCOS IN SAMPLE

LCO#	Name	State	Region
2116	Stamford	CT	Boston
2235	New York Northeast	NY	New York
2236	New York Northwest	NY	New York
2240	Queens Northeast	NY	New York
2416	Flint	MI	Detroit
2423	Midland	MI	Detroit
2425	Saginaw	MI	Detroit
2540	Clarksville	IN	Chicago
2547	La Crosse	WI	Chicago
2626	Minneapolis	MN	Kansas
2629	Rochester	MN	Kansas
2631	St. Paul	MN	Kansas
2713	Concord	CA	Seattle
2718	Oakland	CA	Seattle
2812	Covington	KY	Charlotte
2818	Charlotte	NC	Charlotte
2833	Rock Hill	SC	Charlotte
2911	Birmingham	AL	Atlanta
2912	Gadsden	AL	Atlanta
2951	Newnan	GA	Atlanta
3043	Laredo	TX	Dallas
3112	Phoenix North	AZ	Denver
3114	Phoenix South	AZ	Denver
3115	Scottsdale	AZ	Denver
3226	Los Angeles Downtown	CA	Los Angeles
3245	West San Fernando Valley (Woodland Hills)	CA	Los Angeles
3251	Pasadena (Monrovia)	CA	Los Angeles